JAN 14 1935

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January 10, 1935

Engineering News-Record

The President's Call

CONSTRUCTION has been chosen to lead back to recovery by reemploying the 3½ million workers still idle. The program outlined by the President is to create permanent wealth on a self-liquidating basis, and is to be so conducted as to encourage the revival of private initiative. Types of work include highways, grade-crossing elimination, housing and service improvements of the country's communities. It is a program sound in objective and principle and bringing new hope through the knowledge that unemployment is to be relieved by creative work rather than by the dole.

TO THE construction industry it carries a challenge. The task set is far from easy. Extraordinary speed and coordination will be required if several million men are to be given jobs within a few weeks or months. The deliberate procedures of normal times will not do. Public officials, engineers, contractors, all who are connected with construction in any way, are under new and larger responsibility. Their readiness to fulfill the obligation placed upon them, and the power of a newly integrated construction industry to assure an unprecedented harmony of action, will spell success or failure.

DEEP SHEETPILE CUTOFF WALL FOR FORT PECK DAM

A REGIONAL DEVELOPMENT PROJECT OF PIONEER DAYS

LEGAL BULWARKS AGAINST ROAD TAX DIVERSIONS

Winter Idleness is OLD-FASHIONED

A narrow arch bridge on a road in Indiana being extended in mid-winter with Armco MULTI PLATE. The fill is placed directly against the metal plates.

USE WEATHER-PROOF

ARMCO MULTI PLATE

IT used to be customary, when winter approached, to stop practically all construction work. But we've since learned that "winter idleness" is far more costly than winter construction. We've learned, too, that by using "winter-proof" materials, construction costs are but little if any higher than in summer.

Many of those in charge of building culverts, small bridges and other drainage structures have found that Armco Multi Plate is an ideal winter construction material. The thick, deeply corrugated iron plates are quickly bolted together on the job, into pipe or arch form. They require no protection —they are frost-proof. And being of flexible, rust-resisting Ingot Iron, they assure a strong, durable structure.

Plan to keep your men busy this winter, doing really worthwhile work. Without obligation, the nearest Armco man will gladly give you full details on Armco Multi Plate—in terms of your winter construction problems. See him or write.

ARMCO CULVERT MANUFACTURERS ASSOCIATION
Middletown, Ohio

FOR ECONOMICAL MULTI ARMCO PLATE WINTER CONSTRUCTION

For Business Sense in Highway Policy—I

DURING recent weeks controversy has raged between government and the electric power utilities. Government says it will exact lower rates, even though it must go into the power business on its own hook. Some government spokesmen have impugned the business wisdom of the power companies, contending that lower rates would foster greater volume and thereby react to the advantage of the companies as well as of the consumers.

All this sounds like an idea that has achieved conspicuous success in many lines of industry; certainly it is sufficiently in keeping with sound principle to make it worth consideration by those who seek a constructive solution to the controversy between government and the utilities.

But how amazing that public officials can see this principle so clearly in the case of power utilities, which they do *not* operate, and be so blind to it in the case of another utility over which they *do* exert a profound influence. And what assurance is there that, once government should enter the electric power business, it would not forget its wisdom and perform there with no more sense than it now exhibits in that other field?

One of the most widely and intensively used of public utilities is highway transportation. Directly or indirectly it pervades every department of modern life. As an essential community service it ranks with electric power, water or sanitation. And quite aside from its service function, it plays an enormous part in the national economy, generating a vast volume of employment for both labor and capital.

It happens, however, that this vital utility is not integrated through central ownership or operation as are the railroads, power companies and other utilities. One industry supplies the vehicles, another the fuel, still others the tires and other essential accessories. Another provides facilities for parking and garaging, still another those for the repair and maintenance of vehicles. Many of these industries are in turn subdivided into innumerable independent operating units.

Moreover, each vehicle or fleet of vehicles is operated by still other independent agencies—most of them by individuals, some by corporations. And finally the improved highway, so essential to the operation of this far-reaching transportation function, is built, maintained and repaired by the public through many governmental agencies.

Because of this infinite subdivision of function, few are conscious of the actual unity of this process. Few realize that motor transportation as a whole is just as concrete a function as railroad transportation, power supply, sanitation or any other public utility. From the building of the highway to the operation of the vehicle the process as a whole is subject to the same economic considerations that apply to all utilities: it will be well managed or mismanaged, it will perform its function efficiently or inefficiently in proportion as it conforms to those considerations.

During the last quarter century noteworthy progress has been achieved in reducing the first cost of vehicles, fuel and the accessories that enter into motor transportation. Largely as a result of this the use of the highways has increased vastly, to the enormous advantage of the labor and capital employed in the many divisions of industry as well as the social and economic progress of the nation. It has been estimated that motor transportation activities represent the third largest item in the American consumer budget, exceeded only by those for food and shelter.

For years past the community has collected its direct charges for providing and maintaining the highways in the form of registration fees and gasoline taxes. The former constitutes a readiness-to-serve charge, the latter a direct usage charge, or toll. Under reasonable charges highway transport has prospered, increasing from year to year the revenues available to extend, modernize and maintain the highway system, thereby building up traffic volume, lowering operating costs and reducing more and more the burden that formerly rested upon landowners and the general public.

In other words, government applied to highway transportation the principle it now commends to the power utilities, i.e., the establishment of charges designed to foster increasing use with resultant general benefits in the form of widespread transportation economies and a far-reaching stimulus to the private employment of labor and capital. Recently, however, many governmental agencies have abandoned this policy and perpetrated on an increasing scale the very evils against which they now admonish utility management.

Willard Chevalier

(To be concluded next week)

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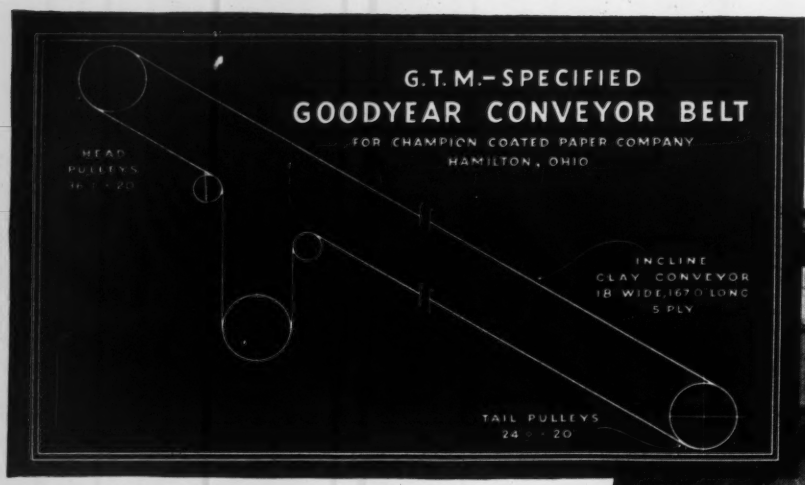
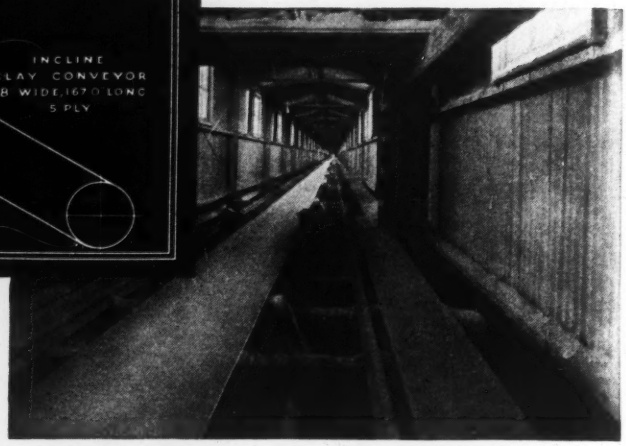
THE CHAMPIONS OF CHAMPION



Goodyear Conveyor Belts set record in world's largest coated paper mill



Installed 1920—and still on the job

14 years' service proves value of GTM Specification

IN THE great modern plant of The Champion Coated Paper Company at Hamilton, Ohio, three veteran conveyor belts have quietly proved themselves champions by every test of belt performance.

Back in 1920 the G. T. M. — Goodyear Technical Man — was called to Hamilton and consulted about belts for the conveying system handling the fine clay used in giving Champion papers satin-smoothness.

Carefully considering all factors the G. T. M. recommended a 5-ply Goodyear Conveyor Belt, 18" wide by 167' long, for the incline conveyor. Another 1372' long for the distributing conveyor, and a third, 14" wide by 1440' long, 4-ply, for the reclaiming conveyor. These belts were built to specification and installed in late 1920 and early 1921.

Today, after rolling on their appointed rounds, day after day, month after month, for some 14 years—after moving nearly seven hundred million pounds of clay — these three belts, while somewhat worn to be sure, are still good for another year of stalwart service.

That's the kind of trouble-free, low-cost, uninterrupted performance you want from belts—and that's what you get when you have belts accurately specified to your operation by the G. T. M., as records in scores of industries prove.

Why not see what this competent expert could do for you. To bring him, write Goodyear, Akron, Ohio, or Los Angeles, California — or call the nearest Goodyear Mechanical Goods Distributor.

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F. E. SCHMITT, *Editor* WILLARD CHEVALIER, *Vice-President*

Editorial Staff
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In the News:

BUILDING-MODERNIZATION WORK placed under contract since Aug. 1 has exceeded $200,000,000, according to FHA figures. Work is being reported at a rate approaching $15,000,000 per week, and the FHA estimates that 300,000 men have been put to work by the campaign.

CLEANING AND REPAIRING of the Washington Monument has been completed, and on Jan. 2 the work of dismantling the 555-ft. scaffolding (*ENR*, Dec. 20, 1934, p. 779) was started.

THE $3,117,518 BID of the Dravo Contracting Co. for building the Gallipolis Dam on the Ohio River has been approved by the Chief of Engineers, U. S. Army.

RIVER AND HARBOR WORK totaling $170,000,000 for the coming fiscal year has been approved in the annual report of the Chief of Engineers. Among the major items are included continuing amounts for the Bonneville and Fort Peck projects and $35,000,000 for the work on the upper Mississippi River.

THE OFFICIAL START of construction operations on the $34,000,000 Muskingum River conservancy program in Ohio was made on Jan. 3, when Governor White turned the first shovel of dirt for the Tappan Dam.

FUTURE WORK carried on by Minneapolis as part of the Twin City sewage-disposal project must be let to contract, according to orders received from the PWA, and the Administrator "will not approve of any additional sections of this work being done by the force-account method."

In This Issue:

A 9,500-FT. LENGTH of steel sheetpile cutoff wall, driven to a maximum depth of 150 ft., is one of the first major construction operations at the Fort Peck Dam project to follow the preliminary work of railroad and town building. The cutoff design and the equipment and driving procedure are reviewed.

TO INVESTIGATE the possibility of using plywood gusset plates to improve the effectiveness of the joints in timber construction, a series of preliminary tests is outlined, which indicate results sufficiently promising to warrant further study of this subject.

AS AN EXPERIMENT in brick surfacing for a highway in Ohio, a curbing of brick was grouted onto the fresh concrete base.

THE EVER-INCREASING PRESSURE to divert gas-tax revenues for other uses resulted in a survey of the state statutes and court decisions which prohibit such diversion. This survey was made by the National Highway Users' Conference, and the results are summarized.

RULES HAVE BEEN ESTABLISHED for setting up and operating bid depositories for general building contractors, providing a method for checking the competitive bids submitted.

IN 1926 RUSSIA had no wood-stave pipe, and during 1934 the installations of this type of conduit aggregated 10,000,000 lin.-ft. The development of wood-stave pipe and some of the more important installations are reviewed by the engineer in charge.

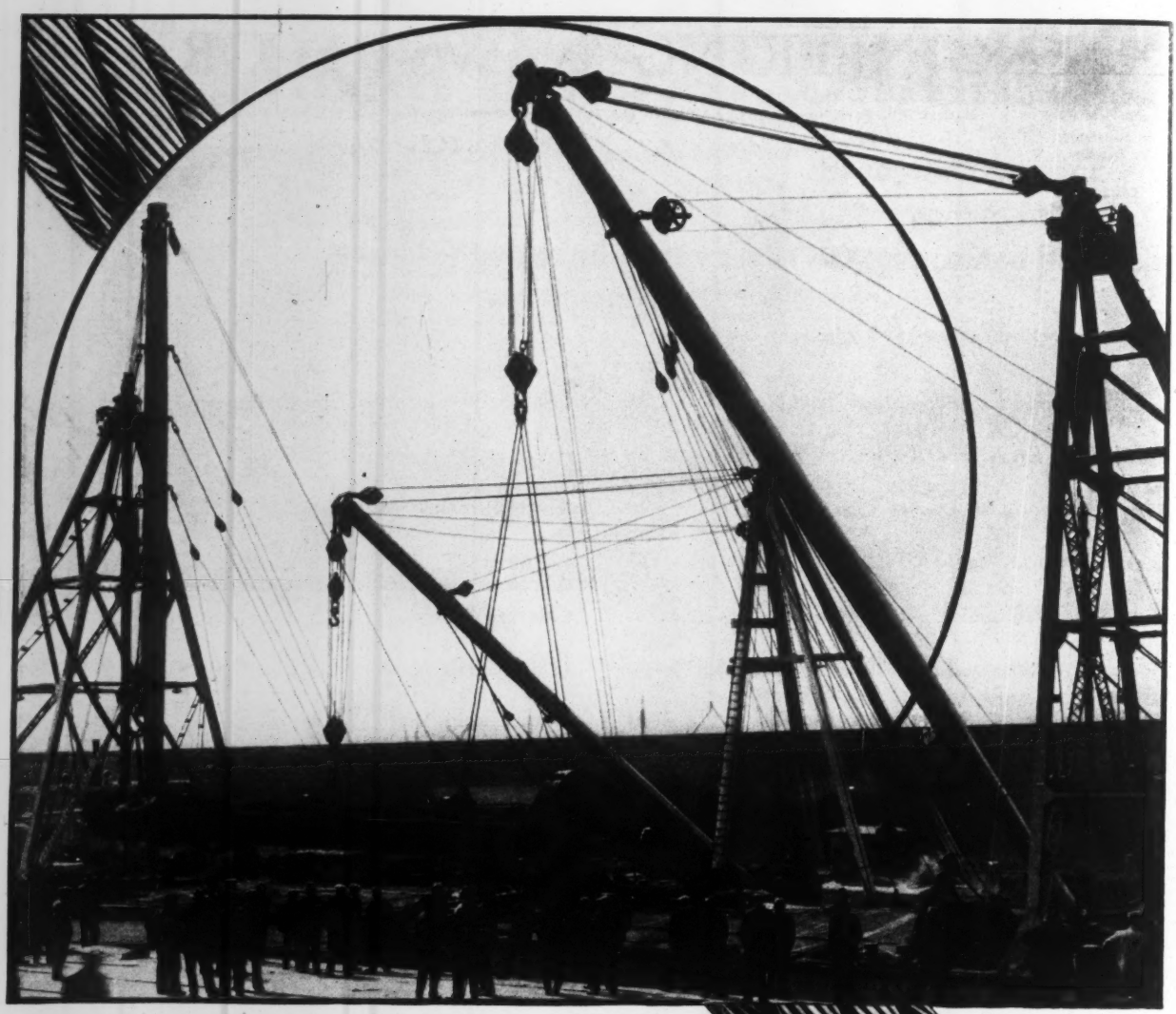
ON A RUGGED, unprotected section of California coast a 2,327-ft. steel pier of welded construction has been built to make possible the conveying of bulk cement from plant to ship. Design and construction of this steel cylinder and H-beam pile trestle are described.

A CENTURY AND A HALF AGO Alexander Hamilton led in founding a corporation designated the Society for Establishing Useful Manufactures, designed to promote industrial manufacturing in the infant nation. The site selected for its operations was where the city of Paterson, N. J., is now situated. Although the industrial phases of the SUM were short-lived, the organization was the dominant factor for many years in the water-supply problems of northeastern New Jersey. The history of the organization and the part it played in the control of the water resources of the region are described.

Coming Articles:

FOR MORE THAN A DECADE Los Angeles County has been actively engaged on a flood-control project on the San Gabriel River. The original high concrete dam to provide the main storage was abandoned, the subsequently planned No. 2 rockfill dam is finished but undergoing extensive repairs to the upstream facing, and work on the No. 1 dam has been shut down pending a restudy of design. The broad subject of San Gabriel flood-control plan, its history and the status of the two dams will be reviewed in detail soon.

NEXT WEEK'S ISSUE will be the Annual Highway Number, with eight articles by authorities in the field reviewing the engineering problems of the future highway.



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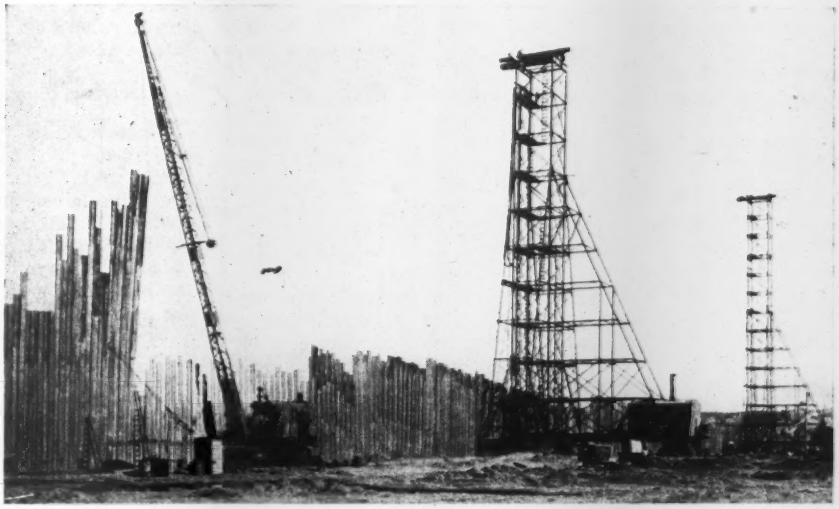


FIG. 1—LOCOMOTIVE CRANE with 100-ft. boom (at left) aids in welding on additional lengths in the air necessary to drive piles to seat in the solid shale. Mobile towers follow and drive piles to full depth.

Deep Sheetpile Cutoff Wall for Fort Peck Dam

Driving sheetpiles 150 ft. to shale requires traveling towers nearly 200 ft. high to handle the longest piles, jet pipes and hammers—Piles are spliced in the air by welding

TO REDUCE percolation through the alluvium under the Fort Peck hydraulic-fill earth dam across the Missouri River, 20 miles southeast of Glasgow, Mont., a steel sheetpile cutoff wall is being driven to maximum depths of 150 ft. into shale underlying the flood plain of the dam site. The cutoff wall will extend 9,500 ft. from bluff to bluff and upward into coulees on each bank. Firm shale lies 100 to 150 ft. below the natural flood plain, and sheetpiles spliced by welding are being driven to this depth, utilizing equipment as unusual as is the great depth of penetration required.

Traveling towers nearly 200 ft. high handle the water jets and lift the piles so as to thread them one after the other, in panels of five or six, into the interlock of adjacent piles. Portable diesel, electric pumping and electrically-driven air-compressor equipment of large capacity has been installed on the west river bank. Experiments with various sizes of air or steam hammers have shown definite weights to be proper for the length and thickness of piles used. Close records are kept of each pile by engineers. These factors have enabled contractors to complete by Nov. 1 about one-third of the job without serious hanging up of any pile, though at a few points slight deviation from the prescribed line, 37½ ft. upsteam from the axis of the dam, has been necessary.

Extent of wall

The top of the wall (Fig. 2) is to extend upward 20 ft. into the fill of the dam and make a seal with corewall fines along the center of the structure. At the ends, where the shale comes so close to the surface as to prevent much penetration, the wall will be secured at the base by concrete. Anchors and guy wires (Fig. 3) at 15-ft. intervals will hold the wall firmly in a vertical position. A core trench 5 ft. wide at the bottom and 15 ft. deep is excavated along each side of the sheetpiles after they are driven, to increase the depth of corewall fines against the sheetpiles.

Due to the fact that the river channel is to be maintained in its present location for the first two years while the embankment is being built up on the flood plain on each side of the river, the cutoff wall in this river section will be driven to shale across the river and cut off at riverbed level. Subsequently, when the diversion tunnels are completed and the river is turned through them, extensions will be welded onto these piles to bring the tops the required 20-ft. distance up into the corewall. This procedure will permit driving a continuous sheet from end to end of the flood plain and also incidentally prevent undue erosion in the riverbed. This river section was not in the original contract but has been undertaken as an extra.

Two different weights of shallow arch pile are being used, the bottom tier of alternating 70- and 80-ft. lengths weighing 23 lb. to the square foot, and the top tier weighing 28 lb. The webs of these sections are ⅜ and ½ in. thick. The joints are electrically welded with a 10-ft. lap between adjacent piles obtained by the 70- and 80-ft. alternate lengths and by the use of short sections. The job will require 1,250,000 sq.ft. of piling.

Subsurface conditions

The whole dam site had been thoroughly prospected by borings, to determine the depth necessary to strip off undesirable material. These shallow borings were spaced on 100- and 200-ft. centers, and the information given by them was augmented by numerous deep core drillings to determine the exact location of the dam.

Both the core drillings and the surface foundations were investigated by nationally known geologists and geological engineers. Investigation disclosed that the site was located within the outcrop belt of the Bear Paw shale, a deposit of marine origin that forms the floor of the Missouri River Valley for nearly 100 miles to the east. This shale is uniformly dense and almost impervious, with a capacity of supporting a load of at least 5 tons per sq.ft.

A great number of core borings indicate that on the right abutment the natural shale lies from 10 to 15 ft. below the surface, and in the valley floor a bed of alluvium covers the shale in varying depths to a maximum of about 120 ft. On the left abutment the shale is overlaid with glacial detritus to a maximum depth of 150 ft. This glacial till is mixed with sand strata, composed for the most part of fine sand. When it was determined to include the sheetpile cutoff wall, since deposits of varying degrees of thickness and fineness extend under the whole flood plain, a line of 23 borings about 300 ft. apart was made directly on the proposed cutoff line, 37½ ft. upstream from the dam axis. A drive sample was taken every 5 ft. This 37½ ft. dimension was designed to give the maximum efficiency in reducing percolation and in keeping the line of saturation at the maximum distance from the downstream surface of the dam. Other factors entered, but this was the line established by the hydraulic experts.

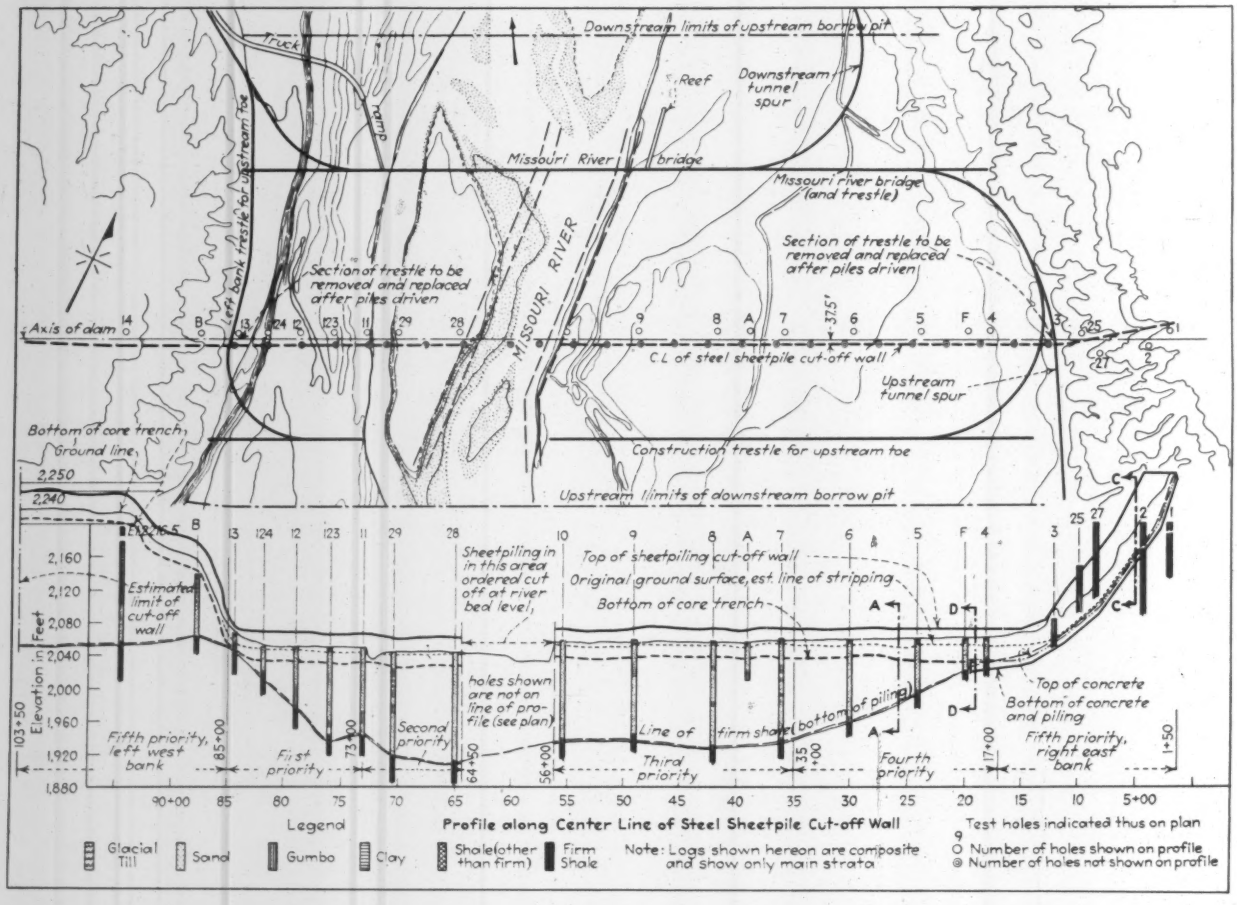
FIG. 2—STEEL sheetpile cutoff wall under Fort Peck Dam is driven a maximum of 150 ft. deep to solid shale. Under right abutment concrete is placed on both sides of feet of piles, and grout is injected in holes 40 ft. deep to seal shale and bentonite seams.

On the east side (right abutment) there is little or no glacial till, and the disintegrated shale has been carried into the flood plain for a much greater depth than it has on the west side. Grouting into the shale along the cutoff line will be extended into the adjacent coulees as experience may indicate is necessary.

Driving plant and procedure

Plant for this contract was assembled on the flood plain on the west side of the river, operations beginning Aug. 30. The driving equipment at present consists of two locomotive cranes with 100-ft. booms, the two 196-ft. traveling towers and three draglines with 100-ft. booms. Another tower will be built on the east side and possibly a fourth.

The procedure is for a locomotive crane to jet down the first tier of 70- and 80-ft. piles. Before starting to drop (not drive) the piles, the jet is lowered three times at points about 12 in. apart ahead of the line of the piles to break up the material. The pile is then raised and lowered, with the jet assisting as necessary. A driver is used only as a last resort on this first tier, since it is felt that alignment and verticality will be more nearly preserved if the pile is not driven by hammer at this stage. Also less interlock friction will


Downstream limits of upstream borrow pit
Truck
ramp
Reef
Downstream tunnel spur
Missouri River
bridge
Missouri river bridge (land trestle)
Left bank trestle for upstream toe
Section of trestle to be removed and replaced after piles driven
MISSOURI RIVER
Axis of dam
CL of steel sheetpile cut-off wall
Upstream tunnel spur
Bottom of core trench
Ground line
Construction trestle for upstream toe
Upstream limits of downstream borrow pit
Sheetpiling in this area ordered cut off at river bed level
Top of sheetpiling cut-off wall
Original ground surface, est. line of stripping
Bottom of core trench
Estimated limit of cut-off wall
holes shown are not on line of profile (see plan)
Line of firm shale (bottom of piling)
Top of concrete
Bottom of concrete and piling
Fifth priority, left west bank
First priority
Second priority
Third priority
Fourth priority
Fifth priority, right east bank
Elevation in Feet
Profile along Center Line of Steel Sheetpile Cut-off Wall
Test holes indicated thus on plan
Legend
Glacial Till
Sand
Gumbo
Clay
Shale(other than firm)
Firm Shale
Note: Logs shown hereon are composite and show only main strata
Number of holes shown on profile
Number of holes not shown on profile

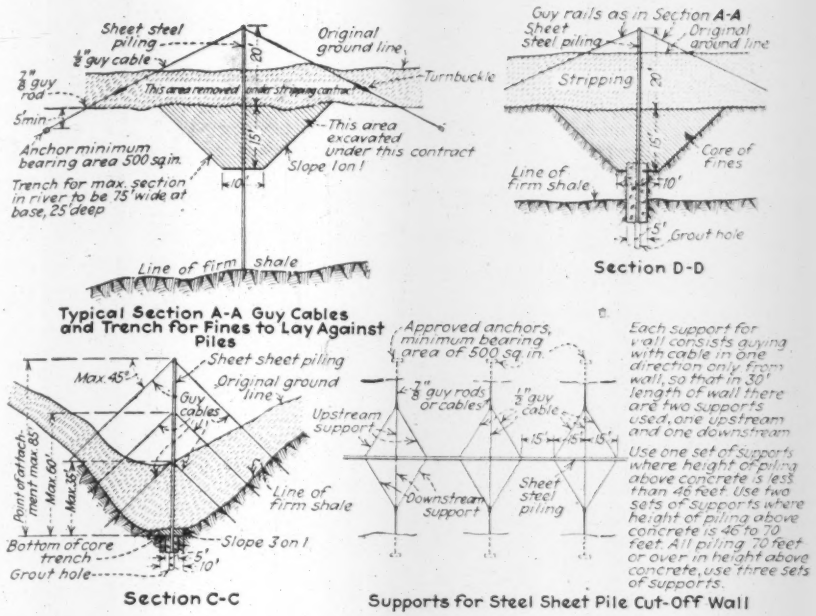

Sheet steel piling
Original ground line
1" guy cable
7/8" guy rod
Turnbuckle
This area removed under stripping contract
5' min.
This area excavated under this contract
Anchor minimum bearing area 500 sq.in.
Slope 1 on 1
Trench for max. section in river to be 75' wide at base, 25' deep
Line of firm shale
Typical Section A-A Guy Cables and Trench for Fines to Lay Against Piles
Guy rails as in Section A-A
Stripping
Core of fines
Grout hole
Section D-D
Sheet sheet piling
Max 45°
Original ground line
Guy cables
Upstream support
Point of attachment max 85'
Max 60'
Max 35'
Line of firm shale
Bottom of core trench
Grout hole
Slope 3 on 1
Section C-C
Approved anchors, minimum bearing area of 500 sq.in.
7/8" guy rods or cables
1" guy cable
Downstream support
Sheet steel piling
Each support for wall consists guying with cable in one direction only from wall, so that in 30' length of wall there are two supports used, one upstream and one downstream
Use one set of supports where height of piling above concrete is less than 46 feet. Use two sets of supports where height of piling above concrete is 46 to 70 feet. All piling 70 feet or over in height above concrete, use three sets of supports.
Supports for Steel Sheet Pile Cut-Off Wall

FIG. 3—GUY CABLES, attached at different heights according to free exposure, support piles above ground.

be developed if the piles are dropped into comparatively open material. If the piles are not driven, no hard driving is developed to be encountered in driving the next tier. The tops of this first tier of piles may be left from 10 to 20 ft. above ground.

The tower then threads on a panel of five or six piles, one after the other. Welding in place is carried out in the air by a portable outfit. The ends are separated about 1/16 in., and metal is run in all around except for the thumb of the interlock, a loss in area of about ¾ sq.in. Tests indicate that the welded section develops 80,000 lb. per sq.in., while specifications call for 70,000 lb. A weld is made in about half an hour's time.

Two piles are usually driven together. The jet accompanies the driving of the second tier but is not forced ahead of the lower end of the piles, since it is felt that undue stirring of the material ahead of the pile end has a tendency to make the pile deviate from plumb.

Determination of when the pile has been seated in the shale follows no formula but is a matter of judgment of the engineers and inspectors watching the driving. The depth to shale is known from the borings and from the depth to which the adjacent piles have been driven. If the driving has proceeded at 15 to 20 strokes per inch penetration and suddenly requires 30 or 40 and the depth reached is essentially that expected to reach shale, driving ceases. A similar increase at a lesser depth would probably be attributed to undue skin or interlock friction or to an obstruction. Few boulders have been encountered, but logs and other water-borne debris have been located. A 5-ft. tolerance above the specified 20-ft. extension above ground is permitted. Above 25 ft. the contractor may at his discretion cut them off or not.

Piledriving towers

The tall towers, designed to withstand 30-lb. wind pressure expected from a 90-m.p.h. gale, are mounted on rails spaced 60-ft. apart on one side of the pile line, the I-beam heads being cantilevered out 12 ft. to permit dropping the jets and piles exactly on line. To this detail is attributed much of the success in following the line. An electric hoist on the platform is provided for the lifting lines, but the movement of the tower forward is by men with pinch bars. Verticality is effected by jacks. Short transverse movement is effected by screws and ratchets adjusting the platform on the trucks. The first towers were 150 ft. high but have been extended to 196 ft. for more convenient operation, mainly of the jet pipe, and for threading on the second tier of piles. The orifice of the jets varies from 1⅛ to 1⅜ in. on the 100- and 150-ft. jet pipe, which has welded joints.

The hammer ram weighs 1,600 lb., and the gross weight is 7,000 lb. It operates at 130 to 135 strokes per minute and uses 600 cu.ft. of air per minute.

Servicing plant

Air is furnished at 100-lb. pressure through a 5-in. header running the length of the active job by a motor-driven compressor having a capacity of 1,230 cu.ft. per minute. As cold weather approached, trouble was experienced with ice from the expansion of the air, so that air washers and coolers were installed in November. However, it is not expected that work can proceed through the winter.

Alongside the compressor plant is the pumping station containing four two-stage 4-in. centrifugal pumps furnishing water for a 12-in. steel header running the length of the active job with

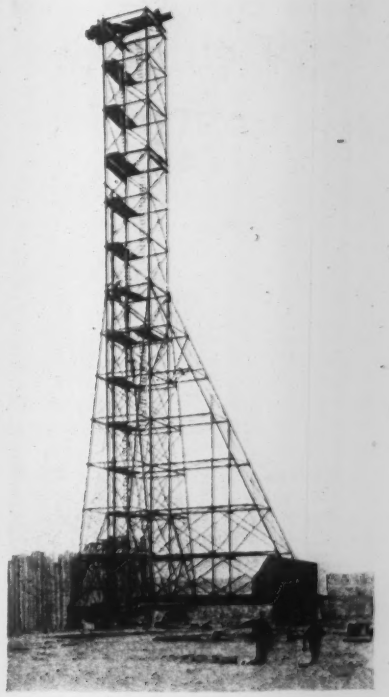


FIG. 4—MOBILE TOWER, 195 ft. high, jets down and drives second tier of 120- to 150-ft. piles. First tier of 70- and 80-ft. piles is threaded on to adjacent piles and sunk to place by cranes with 100-ft. booms, usually without driver but by alternately raising and dropping the pile, which was preceded several feet by the jet.

take-off connections at intervals of 60 ft. and up. Two types of pump installation were made. One pair is powered with 150-hp. diesel engines driving through V-belt to increase the speed, and the other two by 100-hp. motors direct-connected, operating at 3,600 r.p.m. The diesels were put in before electric current was available. An installation of four motor-driven pumps and two compressors of 1,900-cu.ft. capacity will be made to operate the three hammers on the opposite side of the river. The water pressure is maintained at 175 to 200 lb., and the capacity is 600 g.p.m. These air and water stations are built on concrete foundations well above the expected average high water levels.

Progress by the contractor, Frazier-

Davis Construction Co., and G. L. Tarlton, St. Louis, for whom Charles Gove is superintendent, since starting operations Aug. 20 is considered highly satisfactory. The work is divided into priorities, each with a separate time of completion, but the entire job has an allotment of 300 days. The first priority of 1,200 ft. on the west bank was completed in November, and the second priority, 850 ft. thence to the river bank, was 50 per cent done Nov. 1. Trestles were driven in November, to permit driving the riverbed section of 850 ft. next.

The Fort Peck project is being constructed under the supervision of Major T. B. Larkin, district engineer, U. S. Army, with Major Clark Kittrell in charge of the operations division, which has charge of all construction activities. Captain C. H. Chorpening is directly in charge of cutoff wall construction. C. J. Herbold, associate engineer, is in immediate charge of the staff of engineers and inspectors watching every detail of the cutoff installation. Plans for the project are all prepared in the Kansas City U. S. Engineers Office of the Missouri River Division.

All-Welded Steel Ocean Pier of Tubular and H-Piles

Steel trestle pier on ledge bottom resists severe wave action by welded connections and steel piles driven into rock

By R. C. Helen
District Manager, Merritt-Chapman & Scott Corp., San Francisco, Calif.

AN OCEAN PIER 2,327 ft. long, of welded steel, has recently been completed off the California coast under conditions of hazardous wave exposure requiring anchorage to a rock bottom. A combination steel-cylinder and H-beam pile trestle, well braced and carrying a timber deck, was designed. Construction outshore, bent by bent, fully completing each bent and span before the next bent and span were undertaken, was the procedure adopted. All connections were welded, there being over 5 miles (26,790 lin.-ft.) of welding requiring 22,150 lb. of welding rod. The determination of foundation conditions and the pier and collateral construction required a little over a year from September, 1933, to October, 1934.

Location and design

The completed pier is shown by Fig. 1. It was designed and constructed for the Santa Cruz Portland Cement Co. as part of its plan to transport bulk cement by ship from its plant at Davenport, Calif., to various points along the west coast. The plant at Davenport is located 12 miles northwest of Santa Cruz, Calif., at a point where the seacoast is rugged, unprotected and subject to heavy seas. For a ship to receive cement from the plant it was necessary to have a loading berth where the water depth would be 50 ft. at mean lower low water. This required a pier 2,327 ft. long and a structure stable enough to withstand tremendous seas.

To build the pier in the most practical location from an engineering as well as shipping standpoint and to ascertain the conditions to be met, a bottom survey was made in September, 1933, for the entire length of the proposed pier. This work consisted of determining the nature of the rock bottom (which was found to be a shale formation for the full length of the project) and to take soundings, shale elevations and sand depths. The last were determined by jet soundings made by diver and were found to vary from 6 in. to 6 ft. A careful check was also made to determine the direction of the pier so as to keep it headed as directly as possible into the seas.

From the survey of the bottom it was decided to use steel H-column piles and to drive them to refusal with as much penetration as possible. A test was made to determine the adhesive and bond value of the shale.

As the pier carries only two 12-in. pipe lines for cement, one 6-in. oil line and one 3-in. water line, the load to be carried was almost negligible. The principal problem was to design a structure that would stand up against the constant pounding of the sea. With no protection whatsoever, swells from distant disturbances strike this part of the coast continually, and during winter months 20-ft. seas are not uncommon.

The first 840 ft. of pier consists of 56 bents on 15-ft. centers, each bent having three 33-lb. H-column piles. The two outside piles are battered 1 on 1; each bent is X-braced, and every other bent is swaybraced with 4x4x$\frac{7}{16}$-in. angles. At elevation +8 a sash brace ties the three piles together and a longitudinal brace of 4x4x$\frac{7}{16}$-in. angles carries through on each outside pile of the bent. The piles have a cutoff elevation of +30 and are tied together longitudinally by a truss 4 ft. deep. All braces are electrically welded. The bents are capped with 12x12-in.x16-ft. timbers.

The first 840 ft. from the abutment brought the pier to where the water had a depth of 14 ft. at M.L.L.W. From this point on, heavier construction was used through the breaker line, where the seas have the most force, and to give strength for greater water depths. The heavier construction is illustrated by Fig. 2. The deck arrangement remains the same for the full length of the pier.

Construction procedure

The procedure for constructing the bents was as follows: A temporary guide frame was designed to hold the cylinder piles in place and to provide a working platform while driving them. This frame was held by cables from the last completed bent and at elevation

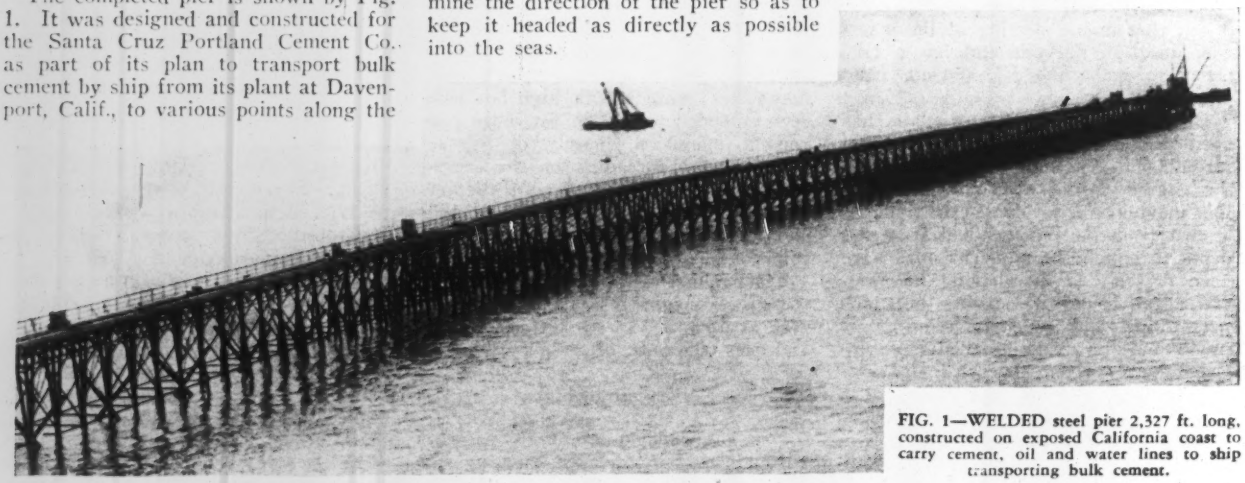


FIG. 1—WELDED steel pier 2,327 ft. long, constructed on exposed California coast to carry cement, oil and water lines to ship transporting bulk cement.

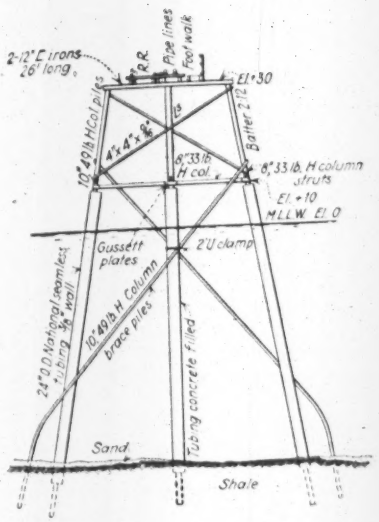


FIG. 2—TYPICAL trestle bent for outer 1,487-ft. part of pier located through the breaker line and in deep water.

+9, or 1 ft. below the cylinder cutoffs (Fig. 3). The frame was left in place until the entire bent was finished and was then picked up and moved ahead for the next bent. With the frame in position, the three cylinder piles were driven and cut off to their proper elevation, the sand was removed by compressed air, and the three standard 10-in. 49-lb. H-column piles were driven under them. The piles were driven with a drop hammer to obtain the most penetration possible. Due to the hard driving it was necessary to cut the piles off several times as the blows would bend the heads.

After the piles were driven, the lower sash brace was placed and spot-welded. The next procedure was to cut the piles to grade and place a temporary 12x12-in.x36-ft. wood cap for supporting the piledriver and to provide a working platform. With this completed, the two 12-in. channel iron caps were hung, and the bent was then ready for X-bracing. Two brace piles were driven and brought into position and welded, the longitudinal struts placed, the bent swaybraced and the trusses hung. The X-braces under the deck were placed and a carpenter crew followed up this part of the construction with the wood deck.

When the steelwork on a bent was completed, the concrete crew dewatered the cylinders and poured the concrete. A 1:2:4 mix of high-silica cement was used, and the concrete was placed through pipes.

Welding procedure

All the welding was carried on in conjunction with the piledriving and steel-erecting operation. The braces were tacked in place and welded. When the bent was completed, the temporary frame was moved ahead and the next bent started. One bent was completed every 24 hours. The welding on each bent was completed before moving ahead. This was absolutely necessary, as any work not tied together would be knocked down by seas that came in with little or no warning.

From March to August inclusive the strong northwest trade winds blow almost constantly along the coast. This conditions made construction of the pier difficult. The wind caused a sloppy sea, slowed up the welding and at night made work on the pier dangerous. The welding was carried on almost entirely from boatswains' chairs. The welding of the bottom braces at elevation +10 was difficult, as seas washed up with little warning. It was often necessary to place one man to watch the seas and to warn the welders and pile driver men to start climbing when a big one came along. The entire structure is electrically welded, there being no rivets or bolts in the permanent work.

A diver followed up and placed the underwater clamps to hold the brace piles to the center pile of the bent. There were 80 bents of pier of the type shown in Fig. 2 on 18-ft. centers. These, together with the 56 bents inshore, made a total of 136 bents of pier.

As there was no approach to the pier, all materials were handled over a 50-ft. bluff with a 100-ft. boom stiff-leg derrick and were carried out onto the pier on cars pushed by a small locomotive. Concrete materials were handled in skips, which were loaded on cars and pushed out behind the concrete mixer, which, itself, was on a car placed behind the piledriver for the concrete shift.

To transport the cement from the storage silos at the plant to the ship, a 360-ft. 6x7-ft. tunnel was driven from the silos to the pier. Two 12-in. pipe lines carry the cement pumped from the silos through the tunnel and out onto the pier to the vessel.

Pierhead structure

At the end of the pier a 36-ft. square pierhead was constructed, supported by four 7-ft.-diameter cylinders anchored into the shale, with six piles driven in each, and filled with concrete. The cylinders were placed 36 ft. apart to form the square and were tied together with structural steel all welded. To place the cylinders, it was necessary to drive falsework piles, and 34 steel H-beams were used, which were later cut off at the ground line by a diver using an oxyelectric underwater cutting torch with power generated with a 300-amp. electric welder.

As there is at all times a ground swell and current, the ship has to lay free from the end of the pier. This is accomplished by eight moorings. The moorings are 16,000-lb. old-fashioned stock anchors, with 60 fathoms of chains, supported by a buoy. Due to the nature of the bottom, the flukes of the anchor are placed in holes dynamited in the shale. The moorings consist of two offshore bow breast moorings, two offshore stern breast moorings, one inshore bow breast, one inshore stern breast, one stern mooring and one bow mooring. To hold the ship to the buoys, 10- and 12-in. manila hawsers are used. The moorings are located so that the bow of the ship can be kept head on into the swells.

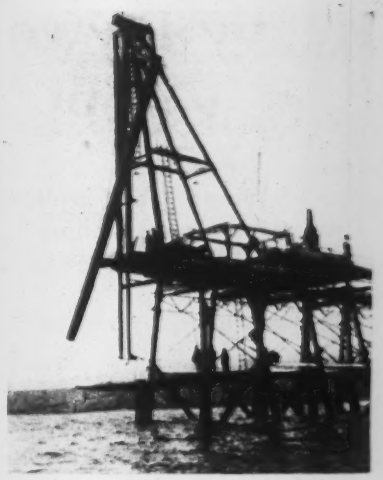


FIG. 3—TUBULAR PILE being handled by piledriver into position for driving.

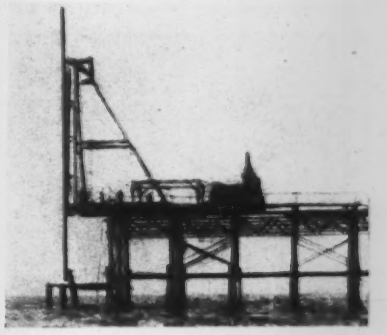


FIG. 4—H-BEAM PILE being threaded into tubular pile ready for driving.

A small derrick at the end of the pier passes two 12-in. hose from the end of the pipe lines to the ship. The ship has a capacity of 44,000 bbl. of cement; 1,000 bbl. an hour pass through each 12-in. pipe line.

The pier was designed and constructed by the West Coast Division of Merritt Chapman and Scott Corp. R. C. Helen was in direct charge of the operations for the contractor. Parsons, Clapp, Brinkerhoff & Douglas, of New York, were called in as consultants on design.

The Lincoln Electric Co. was consultant for the welding operations. All work was done in close cooperation with the engineering and operating departments of the Santa Cruz Portland Cement Co.

Heavy Plywood Sheets as Gusset-Plate Material

Tests of timber joints, incorporating gusset plates of plywood and metal ring-dowel connectors, reveal possibilities for much more useful research on the subject

By H. N. Benkert, F. J. Hanrahan and L. W. Smith
Pennsylvania State College, State College, Pa.

ONE of the most difficult questions in connection with the use of lumber as a structural material is the design of a joint strong enough to develop the full strength of the members entering it. An important contribution in this respect has been made by the introduction of the metal-dowel timber connector (*ENR*, March 30, 1933, p. 408) whose use increases the effective strength of the structure from 2½ to as much as 6 times the ordinary system of construction. However, with all their advantages the connectors are not the complete solution to the problem of timber joints. Even with them, eccentricity cannot always be avoided, and frequently it is necessary to use members of rather large section with the consequent added expense.

In studying the problem the writers conceived the idea of designing a joint making use of a gusset plate or plates. A steel gusset plate might be used, although it would not be entirely practicable. Ordinary lumber was not adaptable, first, because it is very weak across the grain, and second because of the difficulty of procuring it wide enough for the purpose. With ordinary lumber there are also the difficulties of shrinkage, season checks, etc. Heavy plywood seemed to offer possibilities, especially since light plywood had already been used in a somewhat similar manner in airplane construction. Believing that the idea was new, untested and untried, the writers planned a series of simple tests of heavy plywood, to throw some light on its potentialities as gusset-plate material.

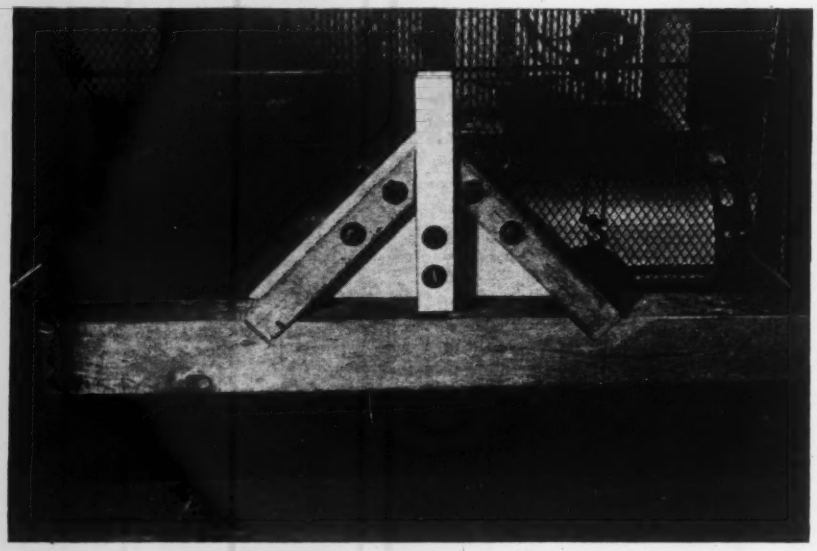


FIG. 1—TEST ASSEMBLY of plywood gusset plate and truss members joined by metal ring dowels. Type 2 specimen.

These tests have now been completed. They were not planned for the purpose of establishing design data but were made solely to determine whether or not the subject has sufficient merit to warrant an exhaustive investigation. In all the tests the loads were brought into the plywood through 2½-in. split rings and ½-in. common bolts. Cast-iron ogee washers were used in the assembly. The methods of assembly varied somewhat for each test; consequently any one test is not strictly comparable with another. No attention was paid to moisture content of either plywood or lumber.

In planning the tests it was decided to separate them into four distinct series as follows: (1) compressive strength of plywood; (2) shearing strength of plywood; (3) load-bearing capacity of metal rings in plywood and also of rings half in plywood and half in fir lumber and (4) strength of plywood used as a gusset plate in a simple joint transmitting loads from one group of lumber members to another, using split-ring connectors.

Two thicknesses of plywood were used: 1⅜-in. nine-ply and 2-in. eleven-ply. Since in each case the two outer plies were only half as thick as the inner plies, half of the wood in cross-section was end grain and half was side grain when loaded either parallel or perpendicular to the grain of the outer plies.

Inasmuch as the purpose of this article is chiefly to point out the possibilities of plywood gusset plates and the fruitful field for research that the necessary study of them supplies, the data obtained in the simple tests carried on by the writers will be presented only in abstract.

Compression tests

The specimens for the compression tests were cut from each of the two thicknesses of plywood, approximately square in section and about 2½ times as long as the thickness of the specimen. The specimens were loaded through a spherical head, parallel and perpendicular to the grain of the outer plies. An initial load of 500 lb. was applied, the deflectometer set at zero and the loading continued uniformly at a rate of 1/25 in. per minute. Deformations were read at increments of 500 lb., and the point of maximum load was noted. Load-deflection curves were drawn from which the ultimate unit compression stress and the modulus of elasticity were computed. The unit stress varied from 3,630 to 4,710 lb. per sq.in., an average of 4,150 lb. per sq.in. The modulus of elasticity varied from 221,000 to 427,000 lb. per sq.in., an average of 346,000 lb. per sq.in.. In Forest Service Bulletin No. 108, the average unit compressive strength parallel to the grain for air-seasoned Douglas fir timber (specimens 2x2 in. in cross-section) is given as 5,002 lb. per sq.in., and perpendicular to the grain as 603 lb. per sq.in., while the modulus of elasticity is 1,200,000 to 1,600,000 lb. per sq.in.

Assuming fir timber and plywood to be of the same species, moisture condition and seasoned condition, the plywood appears to have about 83 per cent of the compressive strength of the timber when loaded parallel to the grain. In general, the plywood specimens carried more unit load when the load was applied parallel to the grain of the outer plies than when the load was applied perpendicular to the grain of the outer plies. On the average, the 1⅜-in. specimens carried a slightly larger unit load than the 2-in. specimens.

Needed Studies—The above results

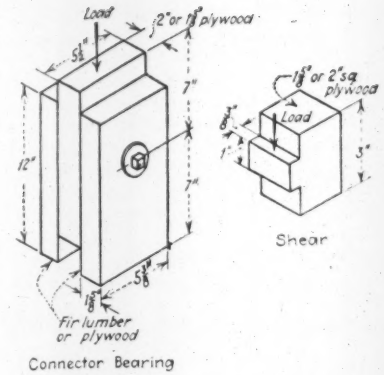


FIG. 2—SPECIMENS used in testing plywood in shear and in determining the load-bearing capacity of metal ring connectors in timber and plywood assemblies.

suggest an interesting and practical field of investigation. Some phases of the problem that could be studied profitably are:

1. The strength of plywoods of other woods—for example, beech plywood, which is a hardwood and can now be procured.

2. The angles which the grain of the wood in successive layers of plywood should make with each other in order that the plywood may be most efficient in load-carrying capacity.

3. The relation of thickness of plies to unit strength.

4. The relation of the size of specimen to the unit strength of the plywood.

5. Glues best suited for carrying stresses.

Shear tests

Eight vertical shear specimens were cut from previously tested air-seasoned plywood gusset plates that had showed no signs of failure. Specimens were either 1⅛ in. or 2 in. square by 3 in. long. Lugs were made ⅜ in. deep (to conform to the depth of embedment of connector rings) by 1 in. high by the width of the specimen, and were located at the center of the 3-in. dimension (see Fig. 2).

The load was applied very slowly parallel to the 3-in. dimension by means of a manual-powered testing machine. Loads were applied both parallel to and perpendicular to the grain of the third ply and both perpendicular and parallel to the plane of the outer plies.

The unit shearing stress in the first four specimens (those in which the plane of shear was parallel to and at about the center of the third ply) varied from 180 to 1,038 lb. per sq.in. and averaged 615 lb. per sq.in. The unit cross-grain shearing stress averaged 285 lb. per sq.in., and the parallel-to-grain stress averaged 945 lb. per sq.in. These four shear tests are fairly comparable to the shearing action of a ring connector.

In each of the last four shear tests (in which the plane of shear was perpendicular to the plane of the plies) there were two distinct failures, the first occurring when the plies with grain parallel to the load let go, and the second when the plies with grain perpendicular to the load let go.

The unit stress for the first failure, which was based on the whole area of the lug, was found to vary from 929 to 1,288 lb. per sq.in., and averaged 1,107 lb. per sq.in.

The unit stress for the second failure varied from 973 to 1,880 lb. per sq.in. and averaged 1,362 lb. per sq.in.

As would be expected when the shear plane is parallel to the planes of the plies, the shear strength across the grain is much less than that parallel to the grain. The average unit shearing stress parallel to the grain, averaging 945 lb. per sq.in. in these tests, compares favorably with the corresponding stress of 822 lb. per sq.in. given for Douglas fir in Bulletin 108 of the Forest Service.

Studies Needed—The authors feel that further investigation of the following problems would contribute valuable data:

1. Unit shearing strength of plywoods made from various woods.

2. Unit shearing stresses at plane of glue between successive layers of plywood.

3. Effect of thickness of individual plies on shearing strength.

4. Effect of different degrees of moisture on the shearing strength.

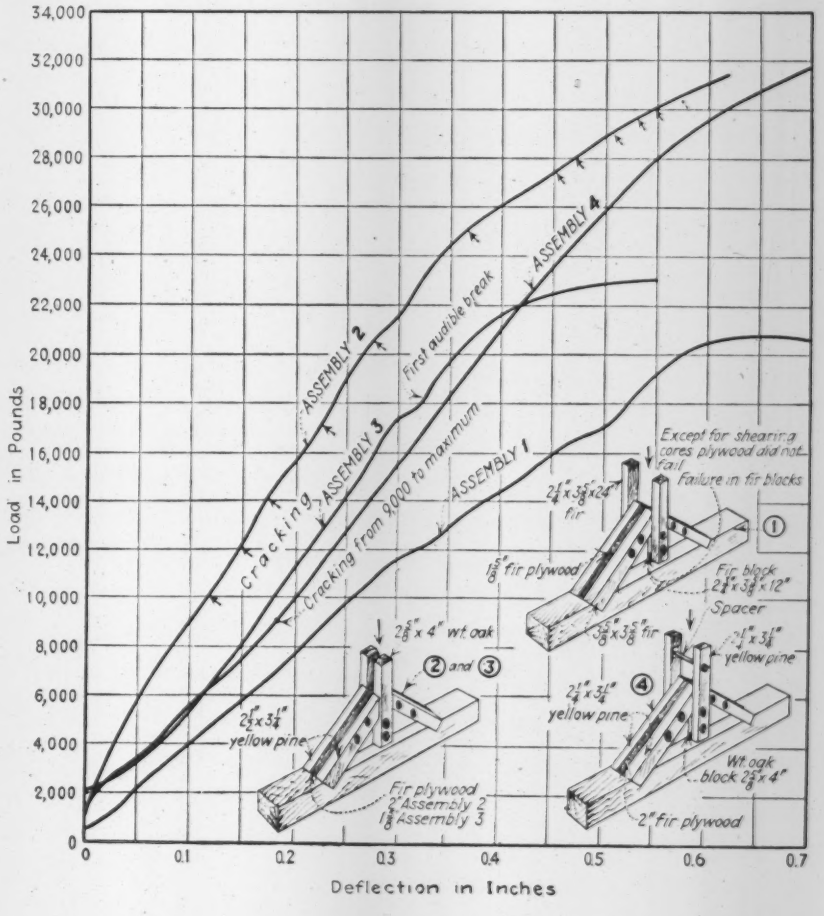
5. Feasibility of either building plywood in such a manner or varying the depth of embedment of split-ring connectors in such a way that the load in shear is always applied parallel to the grain of the plywood.

Connector rings in plywood

A series of tests was made on four similar assemblies built up with metal-ring connectors, as shown in Fig. 2. In two of the assemblies the two thicknesses of plywood were placed between two pieces of fir timber; in the other two assemblies the plywoods were placed between pieces of plywood.

In each assembly the middle piece was raised 2 in. above the bottom of the outer pieces, to permit loading and deformation. A bolt hole was bored 7 in. from the bottom of the assembly, and grooves were cut for the rings. One pair of connectors, one bolt and two washers were used with each assembly. In the plywood the bottom of the ring groove, which was ⅜ in. deep, was placed very nearly at the center of one of the piles.

FIG. 3—LOAD-DEFLECTION CURVES for four different gusset-plate assemblies.



A load of 500 lb. was applied through a spherical head to the middle member, the deflectometer was set at zero, and the loading continued uniformly at the rate of 1/25 in. per min. The deformations of the assembly were read at increments of 500 lb. The loads at which cracking occurred as well as the maximum loads were noted.

Judging from the plotted data of test specimens and from the noises that accompanied the test, the apparent critical loads per pair of connector rings were as follows:

Specimen	Total Load Per Pair of Rings: Shear of Core, Lb.	Ult. Bearing, Lb.
9 ply between fir	13,000	18,720
11 ply between fir	10,500	21,840
9 ply between 9 ply	8,500	16,780
11 ply between 11 ply	8,000	21,330

Since the specimens were not taken apart, to examine the type of failure at the various stages of loading, one cannot be sure that the "shear of core" values given are correct.

As interpreted from the data, the load per pair of rings required to shear the cores averaged 10,000 lb. The ultimate bearing load per pair of rings averaged 19,670 lb. In both "shear of core" and "ultimate bearing," plywood between Douglas fir timber was superior to plywood between plywood. In "shear of core," 1⅝-in. plywood was superior to 2-in. plywood, while in "ultimate bearing" the 2-in. plywood was superior.

Needed Studies—Some of the unsolved problems which arise from the results of these tests and which offer a profitable field for further study are as follows:

1. The relative load-carrying capacity of connector rings in plywood made from other woods.

2. Relation of the tension in the bolt to the load-carrying capacity of connector rings in plywood and timber.

3. The portion of the total load carried by friction and what, if any, part of this load can be utilized in structural design.

4. The portion of the total load supported by the bolt and what are efficient and economical bolt diameters.

5. The most efficient and economical connector-ring dimensions between plywood and the various standard-dimensioned timber.

6. The depth to which the rings sink into the plywood in overturning as well as the corresponding depth in lumber.

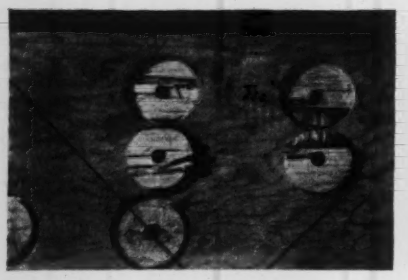
Tests of plywood gusset plates

Two gusset-plate tests were made with each thickness of plywood. For all the tests the plywood was cut in the shape of a right triangle with equal legs 28 in. long. Each leg was fastened between two pieces of lumber (corresponding to diagonal truss members) by a pair of ring connectors spaced 6 in. apart (Fig. 1). The diagonals were embedded into notches in a heavy beam with cement in such a manner that the assembly was truly vertical, with 1- to 1½-in. clearance between the bottom of the plywood and the top of the beam, to permit deformation. The load was applied through a spherical head and a flat iron plate to vertical struts, which transmitted the load through two ring connectors either directly to the plywood or indirectly to it through a pair of lumber filler blocks. Two pairs of connectors spaced 4 in. apart were used between the lumber and the plywood and, where blocks were used, a second set of rings was used to connect the blocks with the struts. The deflectometer was set so as to measure the movement of the head of the testing machine, thus marking the deformation of the assembly as a whole rather than that of any member. With the exception of assembly No. 2, where the machine had to be stopped for readings, the application of the load was uniform and continuous at the rate of 1/10 in. per min.

Details of the several assemblies are shown in Fig. 3. In assembly 1 the diagonals were butted at the apex and the joint packed with cement in order to eliminate or minimize the effect of secondary stresses. At the apex the diagonals were cut down to a thickness of 2½ in. in order that the struts might clear.

Assemblies 2 and 3 were intended to permit secondary stresses. With this end in view, the diagonals did not meet at the apex but were cut away sufficiently to permit the struts to work between them. Since no blocks were necessary, the struts were connected directly to the plywood gusset material, using two pairs of rings and the usual bolt. A simple set of wooden levers with an attached scale was fastened to the diagonals at the apex, to measure the relation at the top of the diagonals, and a similar set of levers was attached to the bottom of the diagonals, to measure the movement at that point.

Since in the first assembly it was found that the short fir blocks were not strong enough to develop the strength of the plywood and that column action developed in the struts, white oak blocks were substituted in assembly 4 and a pipe spacer was bolted between the struts. In other respects the assembly was similar to No. 1, except that since fir was no longer available, yellow pine was used for diagonals and struts.



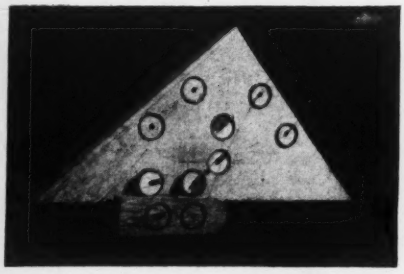


FIG. 4—TYPICAL VIEWS of gusset-plate test specimens. Left: type 1 assembly with vertical timber block and strut removed and set at one side. Center: gusset plate from type 4 assembly after failure. Note how ring dowels in holes along vertical line sheared off the material. Right: typical core failure in a gusset plate of a type 3 assembly.

From the plotted test data (Fig. 3) and the cracking noises accompanying the test, the following values were tabulated:

Assembly Number	Total Load on Struts (Carried by Two Pairs of Rings): First Evidence of Shear of Cores, Lb.	Ultimate, Lb.
1	11,500	20,800
2	10,000	31,000
3	17,000	23,000
4	9,000	35,000

Since the joints were not taken apart for examination at the various stages of loading, one cannot be sure that the "shear of cores" values are correct. However, on the basis of the above data the average shear of cores was 11,900 lb., and the maximum total load for the two pairs of rings in the struts averaged 27,400 lb.

The test indicated that 1⅝-in. plywood was definitely superior to the 2-in. plywood in "shear of cores" load. Two-inch plywood, on the other hand, was definitely superior to the 1⅝-in. plywood at the "ultimate load." A higher load in shear was carried in "shear of cores" without blocks between the gusset plate and the struts than with blocks. In no case did the plywood between the rings shear out, thus indicating that it may be possible to space the rings more closely.

Needed Studies—The surprisingly high load-carrying capacities of plywood gusset plates with connectors, as revealed in these preliminary tests, point

toward great possibilities in the future development of this type of timber joint. Further investigation is necessary to procure accurate design stresses and formulas. It would be desirable to have or to know the following:

1. Design values determined from numerous accurate tests of plywood made from various woods.

2. An analysis of stresses, determination of appropriate safety factors, empirical design formulas, and verification of such formulas by tests.

3. The effect of timber shrinkage and tension of bolts upon the strength of joints.

4. The effect upon joints of moisture within the range of atmospheric moisture variation when sheltered from the elements, as well as the effect of moisture when exposed to the elements.

5. The effectiveness of waterproofing treatments upon plywood.

6. The usefulness of water-resistant and high-strength plywood glues.

7. Economical and practical designs of thickness and size of plywood gusset plates and connectors for lumber of standard dimensions.

8. The practical possibilities of using a series of the cheaper and inferior grades of small-size lumber pieces with a series of gusset plates in place of high-grade, large-size, expensive timber pieces.

9. The effectiveness of packing blocks, lacing and other methods for reducing the effective column length of a series of parallel light lumber compression members.

10. The effect of rotation of members on the gusset plate and the secondary stresses.

11. The minimum spacing of the connector rings to be used in plywood gusset plates.

Legal Bulwarks Against Road-Tax Diversion

A summary of statutory prohibitions and of court decisions against the diversion of motor-vehicle taxes from use for highway-improvement work

By Roy F. Britton
Director, National Highway Users Conference, Washington, D. C.

WITHIN a decade after the inauguration of the gasoline tax in the state of Oregon, this form of taxation had spread to every state in the Union. At the outset this tax appeared not objectionable, as it promised the motorist better roads. It set up what has been termed a "benign circle": better roads meant, in addition to lower operating costs, greater encouragement to use the roads; desire to travel promised more sales of automobiles; more sales of automobiles brought on greater gasoline consumption and more funds for roads. All in all the prospect was a happy one. This was based on the premise that the tax was levied to secure funds for road betterment; but in recent years a cloud has arisen which casts a dark shadow over this happy prospect.

In fact, the flood of recent and impending legislative measures designed to divert these moneys to other than the betterment of highways, seriously threatens the whole highway program and throws tax burdens on motorists which should be assumed by the whole community. Strong constitutional bulwarks may be needed to stop the flood. It is with a view to finding and pointing out these bulwarks that this preliminary study is made by the staff of the National Highway Users Conference.

Constitutional prohibitions

At least four states have adopted constitutional provision which, in the absence of any amendment to the contrary, will effectually prevent diversion of gas tax and motor-vehicle moneys in those states.

Missouri has been generally recognized as an outstanding leader in the fight against diversion. In 1928 a constitutional amendment was adopted providing that the gasoline-tax receipts and the motor-vehicle registration fees should be used only for highway construction, maintenance, administration and the amortization and interest on highway bonds (Article IV, Section 44A).

In Minnesota two constitutional provisions exist which require that both the gas-tax moneys and the motor-vehicle receipts be applied to highway purposes. In an amendment proposed in 1923 and approved by the electorate in 1924, Minnesota provided an amendment to the constitutional provision which prohibited the state from contracting any debts for works of internal improvements with certain exceptions, and it authorized the levy of an excise tax "upon any substance, material, fluid, force or other means or instrumentality or the business of dealing in, selling or producing any or all thereof, used or useful, in producing or generating power for propelling motor or other vehicles used on the public highways of this state and shall place two-thirds of the proceeds of such tax in the Trunk Highway Fund and one-third in the State Road and Bridge Fund." Through this provision, coupled with the constitutional amendment proposed by the Legislature in 1919 and approved by the electorate in 1920, setting up a trunk highway system and specifying the routes and creating a highway sinking fund to which all proceeds of any tax imposed on motor vehicles shall be applied, Minnesota has an effective barrier against diversion (Minnesota Constitution, Articles 9 and 16).

Kansas, through a constitutional amendment proposed by the legislature and approved by the electorate in 1928, provided: "The state shall have power to levy special taxes for road and highway purposes on motor vehicles and on motor fuels" (Amendment to Article 11 being Sect. 9). It appears that this constitutional amendment taken in conjunction with Article 11, Sect. 4, "No tax shall be levied except in pursuance of a law which shall distinctly state the object of the same to which object only such tax shall be applied," will prevent diversion in that state.

An interesting situation is presented in Colorado. The Colorado Supreme Court refused to sanction a levy in addition to the regular motorists' registration fees ranging from $2 to $60 a vehicle on the basis of valuation, the proceeds of which were to be used by counties for relief work. The court held that the act of the legislature violated the constitution of the state in two vital respects: first, that the tax levied in the emergency legislation was in every respect a property tax but one that did no apply uniformly to all classes of subjects in the jurisdiction where it was levied; second, that the constitution prohibits the state from enacting a tax for the special benefit of subdivisions of the state, such as counties, cities, townships, and so on. (Walker v. Bedford, state treasurer, and Charles Gunn, motor-vehicle supervisor of the state of Colorado, Colorado Supreme Court, 26 P (2d) 1051.)

So strong, however, was the sentiment in Colorado against diversion, that the electorate went beyond the supreme court decision and specifically amended the constitution of the state to prohibit the diversion of either motor-vehicle fees or gasoline taxes.

The amendment adopted by the people of Colorado in November, 1934, provides that "On and after July 1, 1935, the proceeds from any license, registration fee, or other charge on the operation of any motor vehicle and the proceeds from the imposition of any excise

tax on motor fuel be, except costs of administration, used exclusively for the construction, maintenance and supervision of the public highways."

In addition to these four specific state constitutional provisions, there is now a federal provision relating to diversion. Congress, in a positive declaration stating that "It is unfair and unjust to tax motor-vehicle transportation unless the proceeds of such taxation are applied to the construction, improvement or maintenance of highways," provided that after June 30, 1935, federal aid for highway construction shall be extended in full only to those states that continue to use at least the amounts that are now provided by law for highway purposes.

Utah decision notable

If a Utah decision were applied in other states, many diversion measures would be invalid. The decision was made on a writ of prohibition asked by a local taxpayer to restrain Salt Lake City officials from awarding contracts for sewer construction in which certain special provisions were made for the benefit of the city's unemployed workmen. The contracts required, among other things, that all work be done by hand labor, that only local men be employed, and that crews be rotated so that as many men as possible could be given work. The city anticipated that these provisions for labor would increase the cost of the project by about 10 per cent.

In deciding the case, the Utah Supreme Court referred to the constitutional provision, Article 4, Sect. 5, which provides, "All moneys borrowed by or on behalf of the state or any legal subdivision thereof shall be used solely for the purposes specified in the law authorizing the loan." The court held that a bond issue of $600,000, passed a few months previously, provided funds for the construction of a storm sewer, but that in view of the provisions for hand labor and rotation of labor in the contracts, there would be approximately $55,000 of the bond issue devoted, not to building a storm sewer, but for charitable purposes. This, the court held, was directly opposed to the principle that money cannot be diverted from the purposes for which it was raised. The court held that the expenditure of the $55,000 would add nothing to increase the value or merit of the storm sewers, and that the provision in the contract which necessitated this expenditure was there for the sole purpose of alleviating the unemployment situation. The court states further, "If peradventure, it should be asserted that all of the $55,000 was to be spent for labor that went into the construction of the sewers, and for that reason it cannot be said in point of truth or fact that there was a diversion of such money to any purpose other than that for which the fund was created, we should be compelled by the admitted facts to say that it was but a thinly veiled effort to do by indirection what cannot be done directly. We have no difficulty in coming to the conclusion that there is a plain diversion to the extent of $55,000 from a fund specifically created by the sale of bonds for the purpose of constructing a system of storm sewers for the purpose of affording employment for the unemployed. This cannot meet the sanction of the law." (Bohn v. Salt Lake City, et al., Supreme Court of Utah, 8 p (2d) 591 (594), 79 Utah 121.)

A number of the states have similar constitutional provisions to the effect that no tax shall be levied except in pursuance of the law which shall distinctly state the object of the same to which the tax only shall be applied. At least a partial list of states containing this provision is as follows: (1) Arizona, Art. IX, Sect. 3; (2) Arkansas, Art. XVI, Sect. 11; (3) Kansas, Art. XI, Sect. 4; (4) North Carolina, Art. V, Sect. 7; (5) North Dakota, Art. XI, Sect. 175; (6) Ohio, Art. XII, Sect. 5; (7) Oregon, Art. IX, Sect. 3; (8) South Carolina, Art. X, Sect. 3; (9) South Dakota, Art. XI, Sect. 8; (10) Washington, Art. VII, Sect. 5; and (11) Wyoming, Art. XV, Sect. 13.

Confirming decisions

The Ohio Supreme Court recently recognized the potency of this constitutional provision, and gave diversion a severe blow in that state when it held that an attempt to allocate gasoline-tax funds to relief purposes ran contrary to this constitutional barrier. (Rogers, et al., v. State of Ohio, ex rel., Lucas, Ohio Supreme Court, Nov. 27, 1934.)

In one of these states, South Dakota, various attempts have been made to divert moneys that have run counter to this constitutional prohibition. An attempt to use motor-fuel tax funds for the purposes of setting up a state-owned system of filling stations and an attempt to use these moneys for appropriating feed or money for carrying citizens' live stock through winter was held to be unconstitutional in view of the fact that the gas tax had been levied for highway purposes, and this, taken in connection with the constitutional provision that the proceeds of the tax must be applied to the purpose for which it was levied, effectively prevented such use of gas-tax moneys. (See White Eagle Oil and Refining Co. v. Gunderson, 205 N. W. 614 in re Opinion of the Judges, 210 N. W. 186 in re Opinion of the Judges 240 N. W. 600.)

The Oklahoma Supreme Court has squarely held that officials can be enjoined from diverting funds raised by bond issue or taxation from the designated purpose. The court states: "Such funds must be used for the purpose raised and designated." (Hickman, et al., v. Board of County Commissioners of Pottawatomie County, et al., 35 P (2d) 960.)

Bond law restrictions

A number of state constitutions have specific provisions relating to bond amortization which provide in substance that appropriation of tax for interest and principal is not to be repealed or taxes postponed or diminished until principal and interest are wholly paid. (Minn., Art. IX, Sect. 5; Neb., Art. XI, Sect. 6; Nev., Art. IX, Sect. 3; N. D., Art. XII, Sect. 182; Wis., Art. VIII, Sect. 6.) Under a constitutional amendment in Alabama the motor-vehicle fees are pledged to the amortization of principal and interest of any bonds which may be issued for state road purposes. (Alabama Constitution, Article XX, Amendment XI, Sect. 1.)

Any diversion which impairs or threatens to impair the obligation of contract between the state and the highway bond or debenture holder may run afoul not only of this specific constitutional provision in those states where such exists, but may run counter to basic legal concepts relating to the sanctity of contracts.

Suppose a state is unable to comply with the provisions of the contract between it and the federal government by which it obligated itself in return for federal aid to maintain federal-aid highways, may this breach or threatened breach be used as the basis for stopping the diversions?

It is "well settled that a state has no more authority to pass a law impairing the obligations of one of its *own* contracts than it has to pass a law impairing the obligations of contracts between individuals." The Kansas supreme court held that there was no ground for the apprehension in this case, that the state, after having made a solemn agreement with the federal government for the borrowing of money for highway purposes, could at some future session provide for other uses of motor-vehicle and motor-fuel tax collections so as to impair the obligation with the federal government. The court holds that the state, having entered into the contract with the federal government, must comply with this contract. (Boynton v. Highway Com. 32 P (2d) 493.)

An attempted diversion of county gas-tax moneys in the state of Minnesota was held to be in violation of the state constitution by the attorney-general in an opinion handed down Feb. 23, 1934. Also a municipal diversion of $159,803.09 of motor vehicle license and gasoline-tax funds for purposes other than "maintaining, repairing, construction and repaving public streets and roads" within the city was held to be transferred illegally, by Judge Nelson Schwab in the Cincinnati Common Pleas Court. The foregoing is only suggestive of the lines of defense which may be drawn to stem the tide of diversion.

A Regional Development Project of Pioneer Days

Alexander Hamilton's SUM—the Society for Establishing Useful Manufactures—made a sad failure of its industrial plans and later became a pawn in a promoter's game to control the water supply of northeastern New Jersey—Today it has settled down in the business of power service

By M. N. Baker
Upper Montclair, N. J.

EXAMINATION of northern New Jersey's topography will show that the streams flowing from the northeastern highlands are ideal sources of water supply and power. Nearly 150 years ago the power possibilities of the region led to its choice as the site for the projected industrial operations of the Society for Establishing Useful Manufactures, founded by Alexander Hamilton in 1791.

The enterprise met with lamentable failure almost at the very beginning of its life. If, in its efforts to establish an industrial community in what had been an agricultural region, the society can be viewed as an analogue of projects such as that of the Tennessee Valley Authority, the SUM has even more sensational interest to engineers concerned with municipal service because for many decades it was used as the chief means for private control of waters essential to the supply of many populous cities.

The accompanying article sketches the brief history of the SUM as an industrial development enterprise, the subsequent growth of a great water-purveying syndicate, and the ultimate establishment of public ownership of the principal water supplies of the region concerned. Incidentally, it tells of the failure of the state's attempts to cope with its water problems through a succession of state commissions.

The author of the article was for more than forty years a member of the editorial staff of *Engineering News-Record* and one of its predecessor publications. As a long-time resident of the New Jersey metropolitan region and a keen student of water-supply problems throughout those years, he is an accredited authority on the subject he discusses. —EDITOR.

WHEN Alexander Hamilton led in founding the Society for Establishing Useful Manufactures nearly a century and a half ago, he expected the society to do what its name implied. Little did he think that it would be compelled to give up manufacturing before it had more than fairly begun, lie dormant a while, revive only to lease and sell land and water power for decades, then join with canal, water power and other holders of water rights in the Passaic watershed in building up a water-supply monopoly; and finally would become once more a purveyor of power.

Early history

The SUM was incorporated by the New Jersey Legislature on Nov. 22, 1791. This was thirteen days before the date of Hamilton's "Report on Manufacturers," which had been ordered by Congress on Jan. 20, 1790. The time between had been spent in gathering and compiling data on the extent of manufactures in the United States. During this work Hamilton became convinced of the great need of the country for manufactories and conceived the SUM as a means to that end.

The charter gave as broad a grant of powers as any promoter could wish.

JOHN H. COOK, present governor of the SUM.

The society could issue stock up to $1,000,000; hold $4,000,000 of property; acquire land, build manufactories, create a town, provide for navigation to and from its factories and conduct lotteries. It was made exempt from local taxation on its manufactories for all time and from state taxation for ten years. Its employees were exempted from poll taxes, military duty and occupational taxes. The charter did not mention water power nor specify a site for the operations of the society.

After some months spent in investigating sites, a square mile of land was purchased, lying on both sides of the Great Falls of the Passaic River, at what finally became Paterson, N. J. By this purchase the SUM, through the doctrine of riparian rights, obtained control of by far the largest water power in New Jersey, situated only a few miles above tidewater. The full value of this control did not become evident until many decades later, when the waters of the Passaic and its tributaries were to be needed to supply the growing municipalities of metropolitan New Jersey. When that time came the SUM joined forces with other corporations possessing either riparian or charter rights in the Passaic and its headwaters, to form a syndicate which controlled the water supply of the larger part of northeastern New Jersey. This domination continued until one by one the municipalities, either individually or through district organizations, bought from the syndicate such works or rights as they needed for complete municipal ownership of their water supplies.

The purchase of the site was announced on July 4, 1792. On the next day the directors authorized the construction of three good-sized mills, in which cotton was to be spun, woven and printed, together with 50 houses for "artisans" and a few for officials.

L'Enfant engaged as engineer

In July, 1792, the society engaged as engineer Major Charles Pierre L'Enfant, a friend of Hamilton, whose notable services in planning the national capital had recently been brought to an end through disagreements with the commissioners of the federal district. L'Enfant was put in charge of all construction work. A wall to carry water from the river across a gully to the mill site had been projected. At L'Enfant's suggestion an aqueduct of the Roman type was substituted. L'Enfant made a grandiose plan for the proposed town, with avenues radiating from a high central point, but no copy seems to be in existence.

Dissatisfaction arose over the cost and slow progress of construction work, with complaints that L'Enfant was more interested in his town plan than in getting the aqueduct and mills ready for use. In September, 1793, L'Enfant was honorably discharged.

Pending the construction of the cotton mill, spinning was carried on in a temporary shed, with oxen for power, apparently beginning early in 1793. The cotton mill was started up in June following, with horses for power. Water power was not available until late in 1794 or perhaps early in 1795. Only a few of the projected 50 workmen's dwellings were completed, perhaps 15.

The society's operations were handicapped from the start. First came the New York panic of 1792, which financially crippled some of the directors and stockholders before they had paid up their subscriptions. There were defalcations by some of the officers and agents of the society, involving the first governor, William Duer. Attempts to raise money from lotteries failed. Some of the imported factory hands proved incompetent. There was unexpected com-

petition from imported goods at low prices. Had not Hamilton used the influence coming from his position as Secretary of the Treasury to obtain loans from a New York bank, the SUM might have collapsed then and there.

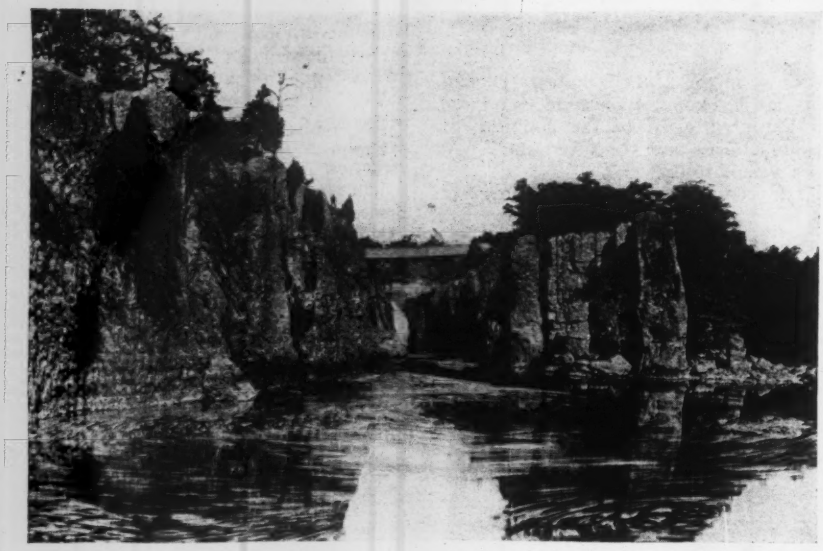
Manufacturing comes to an end

On Nov. 24, 1795, the directors ordered cessation of cotton ginning. Two months later, on Jan. 25, 1796, the superintendent was ordered to stop all manufacturing except that required to fill orders, and early the following March all operations were ordered discontinued and the mills were advertised for rent. On July 8, 1796, the directors decided to summon the stockholders to consider the dissolution of the society. Instead of dissolving, however, the stockholders on Oct. 3, 1796, chose a new board of directors.

So dormant was the society in those days that during the next eighteen years its directors met only three times. For a few years the society leased space to other manufacturers, but in the winter of 1807 its cotton mill was burned down, never to be replaced. That was the final end of Hamilton's vision of "establishing useful manufactures."

Since then, except as a landlord and except for its part in the water-supply syndicate, the SUM has confined its operations to the production and sale of power. For a full century it sold power as water power only. Not until 1912 did it proceed to install a hydro-electric and supplementary steam plant to supply its power customers.

Litigation over the exemption of the company's property from taxation began early and has continued from time to time ever since. In 1854 the exemption was held valid as to property used in manufacturing, which was interpreted broadly enough to include the supply of power to others, but it was ruled that "mountain lands, farmlands, town lots and dwellings" were not exempt, a benefit the SUM had been enjoying for years. Such exemption as the society still enjoys is under protest from the city and county authorities. (Among many sources of information on the SUM the most searching, comprehensive and well documented is "Essays in the Earlier History of American Corporations," by Joseph S. Davies, Ph.D., published in 1917 by the Harvard University Press.)



THE GREAT FALLS of the Passaic at Paterson, N. J., as it appeared in 1866. At this point the SUM purchased a square mile of land in 1792, acquiring thereby dominant water rights in the stream.

Morris Canal and Banking Co.

The year 1824 saw the birth of another of New Jersey's ancient corporations, one that was destined to be first a rival and then a partner of the SUM in the control of the water resources of a rapidly growing region. The corporation was the Morris Canal & Banking Co., which was granted a charter by the state to build a canal between the Delaware and the Passaic rivers. The canal was completed and in operation from Newark to Phillipsburg in 1831.

Until the Morris Canal & Banking Co. began operations, the SUM, through riparian ownership and the use of the stream for water power, had enjoyed undisputed right to the entire flow of the Passaic River at the Great Falls. When it found that part of the feedwater for the canal would be drawn from some of the headwaters of the Passaic, the SUM was stimulated to action. Among other things it decided to consider using its dormant charter right to improve water courses and build canals for navigation.

This charter right was discovered to be of great strategic importance half a century later, for it held the key to the control of the watersupply source vital to extensive communities. The Passaic watershed was the natural source of supply of what in time became the New Jersey metropolitan district, comprising dozens of communities. Only four of the cities lying in Hudson, Essex and Passaic counties had waterworks even as late as in 1880—Newark, Jersey City, Paterson and Passaic, the first two publicly owned and the others privately owned works. All of these cities were supplied by pumping from the Passaic River, the water of which, except at Paterson, was badly polluted.

Two novel proposals in 1828

About the time the SUM decided to build canals, its engineer, John L. Sullivan, made a lengthy report (1828) that included two notable recommendations. The first was that the SUM promote "post railroads" across the state in various directions, as they would be more economical than canals and also would serve as an embarrassment to the canal company. The second proposal was that the SUM supply New York City with water from the Passaic, carried beneath the Hudson by pipes laid on a bed of stone. That was seven years before the first Croton Aqueduct was begun. It was the first of four unsuccessful private schemes to supply New York City with water from the Passaic watershed, in which the SUM was the principal in 1828 and a partner in 1887-'88.

Still larger was the number of proposals to supply New Jersey communities with water from the Morris Canal. From about 1850 until 1880 all such proposals either were initiated by municipalities or else were made to them by the canal company itself. Then intermediaries sprang up, ending with a water-supply syndicate, which included both the canal company and the SUM.

Purchase of water from the canal was considered by Jersey City before it built its first waterworks, which was completed in 1852; and by Newark in 1861, when investigations were being made for the additional supply that was introduced in 1867. From 1860 to 1870 Newark bought small quantities of water from the canal to supplement its old supply from springs and wells. In their annual reports for 1865 and 1868, the Jersey City water authorities alluded to the canal again, first favorably, then unfavorably.

In 1873 the legislature authorized Jersey City and Newark to buy and the owners to sell any water rights

needed for a gravity supply, but forbade taking by condemnation the rights of the SUM, the canal company or the Boonton Iron Co. Before this the courts had held, in lawsuits brought by the SUM against the canal company, that the SUM had the right to the full flow of the Passaic at the Great Falls, but the canal company was not enjoined against diverting to the canal the headwaters of the Passaic because it was turning into the Passaic drainage area water originally diverted from another drainage area. Finally, the SUM and the Morris Canal & Banking Co. pooled their interests. In 1876 the canal company offered to sell all its statutory rights and privileges to Newark for $3,000,000. In 1879, Croes and Howell, in a report to be mentioned later, dismissed the canal as a source of water supply for Newark and other places. The act of 1873 was repealed in 1879, but one was passed that authorized the canal company to sell water.

Water district proposed in 1873

Before taking up the finally successful efforts of the syndicate, mention will be made of projects for joint or district water supplies.

The first of these was proposed by the waterworks authorities of Newark and Jersey City, acting as a joint commission. This resulted in the act of 1873, already mentioned, which authorized not only those cities but any others that chose to join them to introduce a joint gravity supply.

A second district plan was proposed in 1879 in a report to the Newark Aqueduct Board by J. J. R. Croes and George W. Howell. They assumed that any supply developed for Newark would also serve the adjacent territory on the eastern slope of the Orange (Watchung) Mountains. This report was notable for its comprehensive and bold character and its detailed cost estimates for seven different projects.

Some of these projects proposed to continue the use of Newark's pumping station on the lower Passaic, but to pipe water to it from the river at Passaic, Paterson or Little Falls, to avoid using the polluted water of the lower river. A dam across the lower Passaic to keep the tide from carrying Newark's own sewage up to the Newark intake (which, however, was below the sewers of Paterson and Passaic) was considered but was ruled out. A bill authorizing such a dam was introduced in 1882 at the instance of Jersey City (whose intake was near that of Newark), but the bill failed.

The Croes and Howell estimates indicated that for the first five years the least costly of the storage and gravity supplies would be afforded by the Rockaway River, but that during 25 years a pumped supply, piped down the river from Little Falls and lifted at the old pumping station, would be the least costly. Long after, the water syndicate completed works to supply Jersey City from the Rockaway, and a bit earlier it built its famous mechanical filter plant and pumping station at Little Falls, to supply Paterson, Passaic, Montclair and other communities. Jersey City was supplied from these works while the syndicate was completing the Rockaway project.

A notable feature of the Croes and Howell report was the proposal to use riveted wrought iron for all pipes. Ten years later the East Jersey Water Co. used riveted steel in its Pequannock pipe line for Newark.

Activities of promoters

The operations of promoters, including the water syndicate, next claim attention, together with the brief career of the first state water commission and its plan for a district-owned system, to be supplied from the Pequannock River.

In 1881, a water act, said to have been backed by the SUM, was introduced in the New Jersey Legislature. It was defeated. In 1882 it was passed but received a stinging veto from the governor because it enabled a company to exercise the state's right of eminent domain to condemn sources of water supply. The governor declared that this reversed the principle of eminent domain and enabled public property to be taken for private benefit. He held, further, that water supplies should be publicly owned.

First state water commission

The bill and the veto aroused public interest and resulted in the creation, in 1882, of a state water-supply commission, to plan works for one or more municipalities on application. This was the first commission of its kind. Unfortunately, public interest soon died down. No applications were made to the commission.

In a brief report made in January, 1883, the commission urged two enlargements of its power: one to enable it to plan joint water supplies on its own initiative; the other to bring court action to prevent anyone from diverting the waters of the Ramapo, a tributary of the Passaic rising in New York, before they entered New Jersey and supplying those waters to a municipality outside New Jersey. This delegation of authority to the commission was prompted by a report made in 1882 by a "prominent civil engineer" embodying a project to supply New York City from water stored on the New York headwaters of the river. In May, 1883, the New York legislature authorized the Sinking Fund Commissioners of New York City to contract for such a supply with any corporation organized for the purpose. The New Jersey commission referred this matter to the attorney general. Nothing came of the project.

Plan for joint supply

A plan to supply Newark, Jersey City and other communities by gravity from a number of reservoirs on the Pequannock River and its tributaries was submitted by the state water-supply commission in 1884. A 6-ft. riveted wrought-iron conduit, 16 miles long, from a large reservoir above Bloomingdale was a feature of this plan, the conduit to end in a 25x80-ft. standpipe on the mountainside in Montclair, from which metered branches would lead to the various communities to be supplied.

This project, similar to but larger than the one subsequently carried out for Newark by the East Jersey Water Co., provided for a supply of 60 million gallons per day, increasable to 80 m.g.d. by raising the dam forming one of the storage reservoirs (Oak Ridge) and by adding other reservoirs to those first provided. A further increase to a total of 280 m.g.d. could be had, the report said, by developing the Ramapo and Wanaque (the latter was developed years later by the North Jersay District Water Supply Commission). Had this bold farseeing plan been adopted, there would have been no water syndicate but, instead, orderly public development of a water supply for northeastern New Jersey that would have averted the muddle of later years and of today—the twenty-year struggle over the Jersey City water contract, the succession of state water-supply commissions and shifting of powers from one to another, and the rival plans by as many commissions for the additional water supply needed by the district, none of which has yet been adopted.

None of the communities for whom this project was proposed applied to the state commission to carry it further. Due in part to this lack of public interest, but probably more to the private water interests, no further funds were provided for the commission, vacancies were not filled, and the commission became inactive. Its engineer member, Lebbeus B. Ward, who with William E. Worthen as consulting engineer had worked up the project just outlined, gave untiringly of his time and money for years afterward to head off what he conceived to be undesirable, in some cases iniquitous, private schemes to supply Jersey City with water.

Promoter Bartlett appears

Directly after it became evident that none of the joint public projects would be adopted, a promoter named John R. Bartlett began investigations that led to the formation of the water syndicate. He soon learned that to make headway the interests of the SUM, the canal company, the companies then supplying water to Paterson and Passaic, and the

Dundee Water Power & Land Co. (at Passaic) should be pooled; that water storage on a large scale was essential, but that the SUM and the canal company had no power to build storage reservoirs for municipal supply; and that water rights for municipal purposes could be condemned by the municipalities, or in their behalf by private companies who had obtained contracts with municipalities.

During 1886-'88 Bartlett fortified himself with legal and engineering opinion, got powerful financial support in New York City, acquired reservoir sites, and conducted publicity work, all looking to a monopoly of the water in the Passaic watershed and its use to supply not only the New Jersey communities but also the lower part of New York City.

Before he was quite ready to make formal proposals the North Jersey Water Co. offered to supply Jersey City with water from the Pequannock, the source chosen by the old water commission for Newark, Jersey City and other places, at $38.50 per m.g. That was late in 1886.

Immediately Bartlett (Dec. 16, 1886) offered to supply water to Jersey City at an unnamed lower figure, taking it from above the Great Falls, and asked for postponement until he could make a formal offer. This he did in January, 1887, naming $36.50 per m.g. He had as guarantor George F. Baker, president of the First National Bank of New York City. Ten days later the Jersey City authorities accepted the offer, but strong public opposition arose because of the indefiniteness of the proposal and a desire for municipal ownership, and neither concern got a contract. Bartlett's prospectus disclosed that he planned to supply Newark and other places as well as Jersey City.

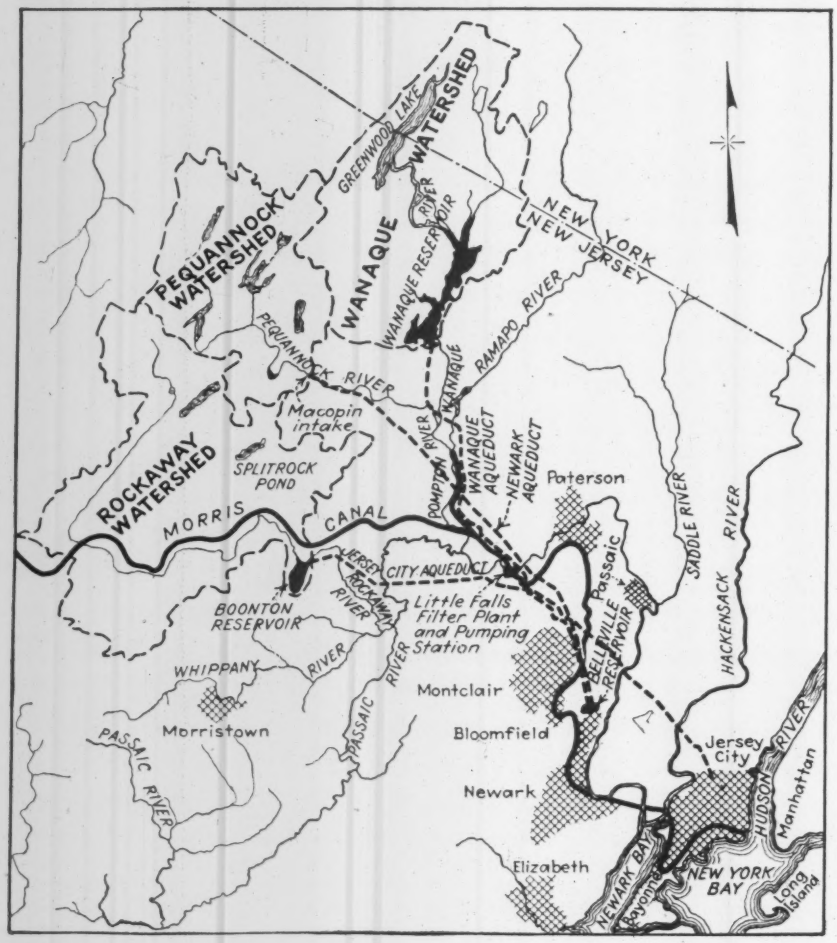
Proposal to supply New York City

Next came the New York project. After elaborate preparation, on Nov. 30, 1888, "John R. Bartlett and Associates" proposed to the New York City Sinking Fund Commission a supply of 50 m.g.d. pumped from the Passaic River above Little Falls to a reservoir and flowing thence to New York. The prospectus in this case was even more elaborate than that used to back the Jersey City proposal. It included many legal opinions on water rights, a brief engineering report by Clemens Herschel, Alphonse Fteley and Capt. J. W. Symons (Corps of Engineers, U.S.A.) and endorsements by more than 100 fire insurance companies, various commercial and professional associations and high military authorities. This proposal was endorsed, under official seals, by the SUM, the Lehigh Valley Railroad Co., the Morris Canal & Banking Co., the Dundee Water Power & Land Co., the Passaic, Aquackanonk and Montclair water companies, and also by the West Milford Water Storage Co.

A novel feature of Bartlett's project was the use of the Hudson River Railway Tunnel, begun in the early 70's but not completed, in which cast-iron pipes would be placed to carry water beneath the Hudson. Notwithstanding all the propaganda, this offer fell flat.

While the Jersey City and New York projects were being promoted the Montclair Water Co. had been created as an opening wedge in the acquisition of unappropriated water rights. It built works for Montclair Township in 1887 and figured in the water syndicate until the end.

MAP OF NORTHEASTERN NEW JERSEY, showing the three large watersheds on the tributaries of the Passaic that have been developed for municipal water supply.



Newark and Jersey City contracts

Differently organized, the water syndicate obtained a contract with Newark in 1889. It agreed to build works capable of supplying 50 m.g.d. from storage reservoirs in the Pequannock watershed, the city to have the choice between buying water by the million gallons and acquiring the works. Newark chose the latter. The syndicate had the right to sell 22.5 m.g.d. between the completion of the works and Sept. 24, 1900. This enabled it to supply several municipalities outside Newark, including Montclair.

After Newark had taken its entire 50 m.g.d. the syndicate fulfilled its other contracts by supplying water from the Passaic River, at Little Falls, filtration of which began in 1902. The Newark contract was signed, on the part of the syndicate, by the East Jersey Water Co. as contractor and the Lehigh Valley Railroad Co. as guarantor. Clemens Herschel was chief engineer, and J. Waldo Smith was principal assistant engineer on this project.

Notwithstanding the growth of Jersey City's population and the increasing pollution of the lower Passaic after the proposals of 1886-'87, Jersey City waited until 1892 before it began its long struggle to get a new water supply. From 1892 to 1898 it took bids eight times.

In 1899 the contract was awarded to Patrick H. Flynn, a Brooklyn contractor, who organized the Jersey City Water Supply Co. to build the works.

Before the city signed the contract, it required a release of all claims to water rights from the Lehigh Valley Railroad Co., on account of the Morris Canal. For this Flynn and associates paid $400,000—which was practically all that the canal company or the railroad ever got from municipalities for the water rights.

Owing to difficulties in financing, the Jersey City Water Supply Co. contract finally went to the East Jersey Water Co. for completion, which was not accomplished until 1904—nearly twenty years after the first offer of water to Jersey City by John R. Bartlett and associates.

Even then, Jersey City's struggle for "pure and wholesome water" was not over. It sued for non-fulfillment of contract as to quality, claiming pollution which, it urged, should be diverted below the Boonton Dam. Installation of a chlorination plant in 1908, the first large one ever built, was held by the court to fulfill the contract; but years later the city put in use an intercepting sewer and an elaborate sewage-treatment plant, built and operated at its expense.

Second state water commission

The time soon came when the district being supplied by the Pequannock, the Rockaway and the Passaic at Little Falls foresaw the need for more water than those works could supply. Joint action by the several municipalities was more desirable than ever before. A second state water commission was created in 1907 to deal with the problem. Between then and its end in 1914, when its powers were merged in a newly created department of conservation and development, the commission made futile attempts to provide a joint water supply, the last of which was a project to supply 50 m.g.d. from the Wanaque, at a cost of $5,000,000. The proposed state financing required a constitutional amendment, which, it was found, could not be obtained.

A similar Wanaque project, with double the capacity, was carried out by the North Jersey District Water Supply Commission. Although created in 1916, this body did not close contracts with the several municipalities for which it acted as agent until 1925, nor did it deliver water until 1930. The district served includes Newark, Paterson, Passaic, Clifton, Montclair, Bloomfield, Glen Ridge and Kearny—eight municipalities in three counties.

Water syndicate ends, SUM survives

By the close of 1930, all the property of the water syndicate had passed into public ownership. The various subholding and local water companies had been dissolved, and the master holding concern—the New Jersey General Securities Co.—had left only the SUM and the Dundee Water Power & Land Co. The Morris Canal & Banking Co. had been taken over by the state in 1923 and "dismantled," at a cost of over a million dollars, and some of its canal bed had been donated to municipalities.

Long before the completion of the Wanaque project the early need for more water by the North Jersey District and adjacent communities became evident. Three projects for more water have been brought forward by as many different commissions, but none has been adopted.

The first project was worked up by Allen Hazen and proposed by the board of conservation and development, to cover the entire state; the second was by the North Jersey District Water Supply Commission, of which the late Morris Sherrerd was then consulting engineer and Arthur H. Pratt was engineer; the third was planned by the state water policy commission, with Morris Sherrerd as chief engineer. Still another state commission—making the fifth beginning with the one of 1882-'84—is now being urged for adoption.

Failure of the early proposals for water districts was due to lack of public support and to the desire of the SUM, the canal company and the railroad company to sell to municipalities water rights granted to them by the state for quite other purposes. Failure of the state to function effectively from 1882 to date has been due to financial and political handicaps. New Jersey cannot issue bonds in excess of $100,000 without a constitutional amendment in each instance. The people of the entire state are loath to vote bonds for the benefit of one section only. Political conditions have militated against the formulation and observance of any consistent state plan for water-supply development.

A history of 143 years

Reverting, in conclusion, to the Society for Establishing Useful Manufactures:

First, it may be noted here that of a half-dozen manufacturing corporations chartered in America from 1789 to 1800 the SUM is the only one to survive longer than a few years. It survived and flourished, however, not as a manufacturer of goods but as a manufacturer and distributor of power. In this it led by many years the water power companies at Lowell and elsewhere; it also anticipated them in the process of building up a great industrial town.

About 1840 the SUM built a new and more substantial dam, near the crest of the Great Falls, as a substitute for its eighteenth century structure. From this dam and the appurtenant raceways it supplied water to the wheels of mills and factories on three levels until, in progress of time and engineering, it substituted electric power, 72 years later.

The lottery privileges granted by the SUM charter in 1791 were surrendered to the state in 1848, after having been a dismal failure in the earliest years of the society and a bone of contention just before their surrender.

After controversies with the Morris Canal & Banking Co. over water rights, extending through many decades, and after other events already sketched, the SUM joined the water syndicate in the '80's. In the '90's it assigned claims to 75 m.g.d. flow of the Passaic River above the Great Falls to the New Jersey General Securities Co., a holding concern organized in 1894 to control the various water supply, water power and other companies with rights in the Passaic River from its headwaters to tidewater.

In 1912-14 the society built a hydroelectric plant with supplementary steam power to produce current for delivery to its customers in place of water to drive their wheels.

A century earlier the SUM had exchanged 300 acres of its lands with the state for 100 shares of stock that the state had bought when the society was organized. In 1852 the city of Paterson sold the last of these lands. It made, says Davis in the book already cited, $30,000 in excess of expense, direct and indirect. Apparently Davis did not take into account capital charges for decades on the original investment.

The SUM has withstood repeated attempts by the city of Paterson to collect taxes on the property of the Society exempted by its charter of 1791, but the city has not given up the struggle. According to data presented in a series of articles designed to aid this campaign (*Paterson News*, Oct. 9 to 23, 1933) the exempted property should bring the city nearly $50,000 in taxes annually.

The SUM today

Today the SUM, after starting out ambitiously to establish manufactures in accordance with Hamilton's ideas, after legal contests with the Morris Canal & Banking Co. and subsequent participation in the water syndicate, sits placidly by the Great Falls of the Passaic and dispenses hydro-electric and steam power to other manufactories of the industrial city which the society helped to develop.

Latest in the long line of governors who have presided over the SUM is the genial 75-year old veteran, John H. Cook, who, beginning many decades ago as assistant to Clemens Herschel, became an increasingly important member of the engineering and managerial staffs of the East Jersey Water Co., the Montclair Water Co., and the Passaic Consolidated Water Co., and a few years ago assumed his present position with the SUM.

Brick Curb Grouted Onto Green Concrete Base

Experiment undertaken by Ohio department of highways to determine practicability of brick curb for brick surfacing on concrete base

A BRICK CURB built integral with the concrete base is a recent experiment of the Ohio highway department on 3,372 ft. of brick-surfaced highway near South Webster, Ohio. This road is also experimental in the use throughout of a 1:9 concrete base. The standards in Ohio have been a 1:7 concrete base and a concrete curb integral with the base and of the same mix.

The lean mix for the base was adopted to secure a lower coefficient of expansion. Because of this lower coefficient of expansion, it was thought that the unavoidable cracks in the base slab, while occurring at shorter intervals, would be so small that adjacent faces would overlock, and the cracks would be so narrow that they would cause no appreciable rupture in the brick surfacing. No joints were provided in the 1:9 base.

A survey of the cracks was made before placing the brick surface. It was found that they did not follow any particular line of cleavage. Some of the cracks were more or less directly transverse, but others crossed the slab at decided angles. All cracks extended through the curb, and their width averaged between ¼ and ½ in. In the 3,372-ft. section with brick curbs there were 47 cracks. The average distance between cracks appeared to be about 72 ft., although actually there was considerable variance in their spacing, the maximum distance being 100 ft. and the minimum 9 ft. The cracks were sealed, before placing the sand cushion, with strips of tarred burlap 6 in. wide.

BRICK-CURB construction on concrete base. (A) Brick set on edge ½ in. into green concrete base. (B) Inside curb form holds brick in place for pouring grout joint filler. (C) Forms removed, showing completed brick curb.

Brick-curb construction

A total of 6,744 ft. of brick curb was built, the construction being as shown by the accompanying views. After the base concrete had been finished by machine, the bricks were set on edge in the wet concrete to a depth of about ½ in., one end being butted against the outside pavement form as shown by view A. Some variance in spacing the brick occurred at first, but this was overcome as the bricklayers became more experienced. As the bricks were laid they were tested for surface by applying a 10-ft. straight-edge, first next to the form and then on the opposite edge of the curb. Corrections in surface were made by tamping down the high bricks or by adding concrete underneath the low bricks. When the bricks were leveled up, an inside curb form was set and clamped to the outside slab form, as shown by view B. The curb was then ready for grout joint filling.

The grout filler was a pouring mixture of 2 parts cement, 1 part hydrated lime and 6 parts sand. It was poured from a pail (see view B) and brushed into the joints, all surplus grout being carefully cleaned off the brick surface. When the grout had set hard, the forms were removed and the finished curb appeared as shown by view C.

A crew of nine men was employed in setting curb; seven were classed as common labor at 50c. an hour, and two (bricklayers) were classed as finishers at 80c. an hour. The crew was divided as follows: Two straight-edging and setting curb forms; two grouting full time; two grouting half time and carrying brick half time; one mixing grout and two laying brick. The labor cost was then $5.40 an hour. It took four 10-hour days for the crew of nine to lay the 6,744 ft. of curb; this gives an average of 168.8 lin.-ft. an hour at a labor cost of a little over 3c. a lin.-ft.

The construction was carried out by the Ohio department of highways, O. W. Merrell, director. The contractor was the General Asphalt Paving Co., Canton, Ohio.

Bid-Depository Rules Approved for General Building Contractors

THE Divisional Code Authority for General Contractors on Dec. 17 approved rules and regulations for the establishment and operation of bid depositories for general building contractors. These rules provide a method for officially checking competitive bids submitted by building contractors only; similar rules for heavy and highway contractors will be made available by the Authority upon request of these subdivisions. Chapter I of the construction code provides that divisional code authorities shall provide, if specific provision is not made in the chapter applicable to such division, a method of checking bids. No such provision was made in Chapter II, resulting in formation of rules by the divisional code authority, effective fifteen days after approval by the Construction Code Authority.

The complete text of the rules follow, except for Par. I, which is confined to an introduction.

2. *Definitions*—The term "building contractor," as used herein, shall be any one who engages in building construction as defined in Chapter II, Article A, Sect. I.

The term "awarding authority," as used herein, and for the purposes as designated herein, shall mean any individual, partnership, association, trust, trustee, trustee in bankruptcy, receiver, corporation or agency which invites bids from, or negotiates contracts with, or receives bids from, building contractors.

The word "agency," as used herein, shall mean any state administrative agency of the Divisional Code Authority for General Contractors, Inc.

The word "depository," as used herein, shall mean an impartial agent or agents designated by the agency to receive sealed duplicates of competitive bids from general building contractors.

A "designated area," as used herein, shall mean any region, or locality, or state, or center of population, or town, or trading area, or a part, or a group, or groups, of any of the above which has been designated by the agency, or agencies, as an area bid depository.

Federal work excepted

3. *Application*—These rules and regulations shall apply to all competitive bids or revisions thereto, submitted on all building construction projects amounting to $1,000 or more, except federal building projects where bids are opened in public. Upon approval of subchapter II-A, the provisions of said subchapter shall prevail.

4. *Filing of Duplicate Bids*—General building contractors shall file with the proper bid depository (that is, the depository in the state or the designated area where the contemplated project is to be located), a duplicate of all competitive bids as described in Sect. 3 submitted to an awarding authority. These duplicate competitive bids shall be placed in an envelope, sealed, properly identified on the outside and filed with the bid depository by delivering or mailing. To be properly identified, the envelope in which the bid is filed must show (only) the following: return address, the addressee, name and location of the job, date and time bids are to be submitted to an awarding authority, the names of the architect and/or engineer, if any, the name of the owner, and the words "building contractor's bid enclosed." If personally delivered, such duplicate competitive bids must be delivered at the depository on or before the date and hour set by the awarding authority for receipt of bids. Duplicate competitive bids that are filed by mail or by telegraph must bear a postmark or filing time stamp, not later than the hour set by the awarding authority for the receipt of bids. All duplicates of competitive bids received by the depository must be time-stamped on the envelope enclosing the duplicate competitive bid immediately upon receipt of same. Building contractors who plan to mail duplicate competitive bids shall, by letter or telegram, so advise the appropriate bid depository in advance.

Opened by request

8. *Opening of Duplicate Bids*—When duplicate competitive bids are received upon a particular construction project, the bid depository shall, upon request of a bidder or the administrator or his representative, and in the presence of two or more bidders, open all duplicate bids not earlier than 10 o'clock of the day following the time set by the awarding authority for the receipt of original bids. At all times, the administrator or his representative shall have access to the bids. Those having anything to do with the bid depository shall not disclose any information with respect to the bids to anyone at any time except as provided herein. In case two bidders are not available for the opening of duplicate bids, the state administrative agency or its representative may be requested by the bid depository to act in the absence of the required number of bidders.

If the awarding authority accepts a bid other than a low bid, the contractor whose bid has been accepted shall, upon request for same by a bidder in writing to the agency, furnish to the agency satisfactory evidence that the price originally bid is the contract price upon which the contract has been executed.

6. *Filing Fees*—The payment of a fee not to exceed $2 shall be paid by each bidder to the depository at the time a copy of the bid is filed. The fee shall be utilized to defray the proper expenses involved in connection with the checking of bids by the depository. The depository shall be required to keep a full record of all of its receipts and disbursements and shall submit an itemized report thereon to the agency at least annually, which report shall be subject to review and inspection by the administrator upon request.

Bids kept one month

7. *Retention of Bids*—Bids shall be kept on file for a period of one month. Should a complaint be filed against a bidder on any project upon which duplicate bids have been filed with the depository, the depository shall keep all of the bids (unless same are requested by a trade-practice complaints committee) on the affected project until the complaint has been disposed of and the bid depository notified of such disposition. All other bids shall be destroyed or returned upon request of the bidder, to the bidder.

Should any trade-practice complaints committee of the Divisional Code Authority for General Contractors, Inc., require any duplicate bid on a project that is involved in a complaint, they shall be given to such trade-practice complaints committee upon request. Such trade-practice complaints committee shall receipt for such duplicates and return them to the depository after the complaint has been disposed of.

8. *Bid Depositories Already Established*—Bid depositories already established for any region or locality shall submit the rules and regulations governing same and obtain the written approval of the Divisional Code Authority for General Contractors. If such rules and regulations are not in major conflict with these provisions, approval will be issued by the Divisional Code Authority for General Contractors, Inc.

9. *Compliance*—Bidders shall not be considered as in compliance with the code if duplicates of competitive bids have not been filed in accordance with the foregoing rules and regulations.

10. *Effective Date*—These rules and regulations shall become effective 15 days after date of approval by the construction code authority and shall continue in force, subject to amendment from time to time by the construction code authority and the Divisional Code Authority for General Contractors, Inc.

Use of Wood-Stave Pipe in Russia Has Advanced Rapidly

Not used prior to 1927, the 1934 installations are estimated to total 10,000,000 lin.-ft.—Study of technical phases keeps pace with development of production process

By Engineer A. Popkow
The Leningrad Institute of Water Supply & Sanitary Engineering

USE of wood-stave pipe has developed extremely rapidly in Russia during the last few years. Beginning with the initial construction of 72,500 lin.-ft. of this type conduit in 1927, there has been such an increasing demand for the material that the 1934 production is estimated at 10,000,000 lin.-ft. Prior to 1927 there was no wood-stave pipe in Russia. As a result of the general study of the national industrialization program beginning in 1926, it was evident that the country would experience problems resulting from the shortage of metal, and this situation turned technical attention to the possible use of substitutes in all phases of construction where metal could be replaced by other material.

It was this search for a substitute for metal which led to the large-scale development and use of wood-stave pipe. In the field of water supply and hydraulic engineering the amount of steel and iron required for the transporting of water was a particular problem, and the use of timber as a substitute was a natural solution taking into consideration the abundance of the material in the Union.

Program of study

In 1926 a group of men under the direction of the author began a thorough study of the technical literature on this subject as a basis for a careful analysis of the problem. Most of the literature was American. The principal deficiency in the information was on the methods of manufacture, as compared to the amount of technical data on hydraulic properties and methods of installation. For this reason the processes of production had to be developed as the study progressed, and this involved the design and building of some special machines, carried out by the same group of men.

By the end of 1926 this program of study and experiment had resulted in the completion of the first shop to produce wood-stave pipe, under the control of the State Melioration Institute. The first wood-stave pipe production in Russia was carried out in this shop in 1927, when 72,500 lin.-ft. were produced. As a result of the initiating of this research program and the establishing of a production organization, the use of wood-stave pipe has been an important element in the water supply and hydraulic construction projects built in Russia during the last few years. The table shows the production of wood-stave pipe in Russia for the last six years.

Year	Lin.-Ft.	Year	Lin.-Ft.
1928	7,500	1931	1,300,000
1929	65,000	1932	2,100,000
1930	750,000	1933	2,500,000
1934		10,000,000 (?)	

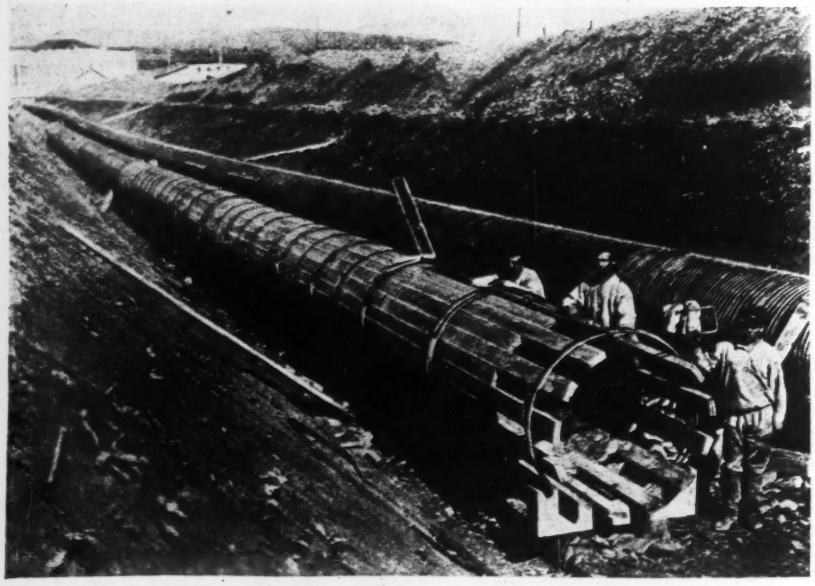


FIG. 1—TWIN 44-in., continuous wood-stave conduits which tested less than 100 gal. of leakage per day per inch of diameter per mile of pipe.

Following its fundamental work in 1927, the Scientific Institute turned over the production phases to the proper industry and the further study of the technical problems to the Leningrad Water Supply Institute.

Design features

Material used for production of wood-stave pipe in Russia is chiefly pine, although larch is used to a limited extent and fir has been used in rare instances.

Although the planks used for the manufacture of the staves are usually of high grade, they are considered to be much inferior to those specified for the same type of use in the United States because of conditions in the timber industry which do not permit the same careful selection of material. The boards are artificially dried to reduce the moisture content to 12-15 per cent.

Production operations include the making of both the continuous and machine-banded types of wood-stave pipe. The continuous pipe, as built in the field, is fastened with steel rods and cast-iron shoes. The design of these shoes is generally the recognized American type, although in some cases iron shoes of Soviet design have been successfully used. The machine-banded pipes are wound with galvanized wire with the usual spiral winding, using a tightening machine that is of Soviet design and developed by the author.

Important projects

The wood-stave pressure conduits that convey water to the Harriousov hydro-electric plant in the Altai Mountains consist of two 44-in.-diameter lines, each 2,475 ft. long. The head on the line is 198 ft. When the line was tested, leakage was found to be less than 100 gal. per day, per inch of diameter, per mile of pipe. At the beginning of operations a sudden load reduction produced a water hammer estimated to have increased the pressure head to 400 ft.

This sudden increase in pressure resulted in bursting some of the iron-pipe branches that connected with the lower end of the supply line, but the wooden pipe showed only a small amount of leakage, which was easily remedied by tightening the bands.

FIG. 2—LARCH STAVES, 2½ in. thick, and oak tongues were used for this 64-in.-diameter conduit, which was supported on concrete saddles to equalize 10 ft. of backfill cover.

This line is of continuous pipe, with staves made of larch and splines of galvanized iron. The pipes are supported on beams placed at 10-ft. intervals. Construction operations are indicated in Fig. 1.

A wood-stave conduit built in 1928 was provided to supply cooling water from the Uda River for the Charkov Power Station. The staves of this 64-in. conduit, 1,320 ft. long, were made of larch. The thickness of the staves was 2½ in., and the tongues were made of oak ¼ in. thick. This conduit (Fig. 2) was supported on reinforced-concrete saddles that were used because the pipe was to be buried deeply, with cover up to 10 ft. in thickness, and the saddles were designed to relieve the local stress at the bottom of the pipe.

Two wood-stave conduits were provided for the Kusnetzk metallurgical plant built in 1931. Each of the lines is 52 in. in diameter and 11,550 ft. long. The staves for this line were made of pine 2 in. thick, and the tongues were of oak. Under test, this conduit (Fig. 3) showed a leakage of about 400 gal. per in. in diameter per mile length. Some trouble was experienced as the result of water hammer, but the damage was repaired without difficulty.

Moscow water-supply line

To provide an additional supply of water from the Moscow River to the filters of the Rublevskaja pumping station near Moscow, a 48-in.-diameter wood-stave line 4,160 ft. long (82-ft. head) was constructed. The thickness of the pine staves in this line was about 2½ in.; the increase, as compared to the ordinary stave thickness for the head involved, was made for the purpose of adding to the life and dependability of this important conduit. As a result of the stave thickness, the conduit proved to be rather rigid and was constructed without the ordinary supporting members.

When this line was put into operation, an accident occurred which placed a severe test on the wood-stave pipe. A valve gate broke at the lower end of the line; and although air valves were provided in the line, these were not in operation at the time, and the water in this 4,000-ft. conduit drained in 30 min., placing an unusual external pressure on the line as the result of the vacuum formed. The line was not seriously damaged, which may be explained by the unusual thickness of the staves compared to the pipe diameter. After the line had been in service for two months, the leakage was found to be 300 gal. per inch in diameter, per mile of length. It might be expected that this size of line would have a smaller leakage than that indicated, but undoubtedly the accident damaged the line more than observation showed.

FIG. 3—MOSCOW WATER SUPPLY has been augmented by the construction of these two 48-in. conduits, each 4,160 ft. long.

In addition to these specific projects already built, there is a project proposed for the Big Volga River, which anticipates the construction of three wood-stave inverted syphons about 43,000 ft. long and almost 30 ft. in diameter. These examples indicate the rapid development of this industry, which has built about 7,000,000 lin.-ft. of pipe line in the six years since its inception.

Research progress

During this construction period careful research work has been going forward in the Institute of Water Supply and Sanitary Engineering. Although it is impossible to review the scope of this research program, it may be indicated by listing some of the topics being studied: leakage from wood-stave pipe; probability of freezing and its effect on wood-stave pipe; influence of external load; establishing of standard rules for pipe laying; standardization of pipe staves and metal parts; protective compounds for covering wood-stave pipes; and possible use of wood-stave pipes for hot water. Further, the institute has studied the problem of improvement of the production process and has developed an idea of the author's for coating the machine-banded pipe with a corrosion-resisting compound during the winding process.

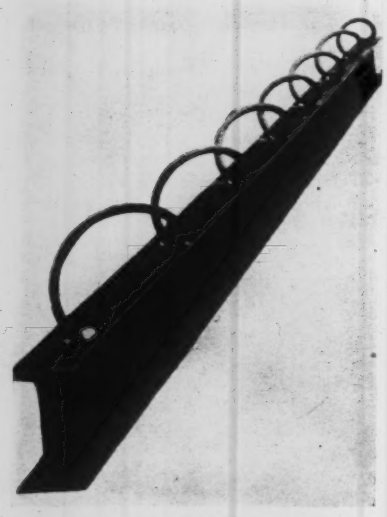
In keeping with the general national program, strenuous efforts have been made to improve and rationalize all labor-consuming processes, by replacing hand labor by machines. A machine, whose design was suggested by the author and Institute Engineer Romanovsky, was designed for the complete mechanization of the entire pipe-laying process, beginning with trench excavation and including all phases of pipe-laying and concluding with the trench-backfilling.

The purpose of this article has been to acquaint American engineers with the development of wood-stave pipe construction in Russia during the past few years and to acknowledge the extensive American literature on the subject, which has proved to be of invaluable assistance and guidance in the development and organization of this new industry.

From Job and Office

Shear Spiral for Composite Steel and Concrete Slabs

A NEW DETAIL known as a shear spiral, consisting of corkscrew-shaped round steel bars of ½- to ⅝-in. diameter welded to the top flange of steel I-beams or channels, is claimed to provide an efficient shear connection between the steel element and a superimposed concrete slab. Developed by a Swiss engineer named Schaub, this "Alpha" construction, as it is called, has been used in both buildings and bridges in Europe. It is claimed to reduce the deflections materially and to permit an appreciable saving in structural steel.



SPIRAL BAR welded to steel I-beam for resisting the horizontal shear between the I-beam and a superimposed concrete web.

Slide-Rule Solves Quadratic and Cubic Equations

By David B. Hall
New York State Department of Public Works, Albany.

IF THE SLIDE of a slide-rule is set in a particular position and the glass runner is moved along the rule, all the pairs of numbers that the runner marks off have some property in common, depending on what scales are considered. For instance, the numbers on the *C* scale are twice the numbers on the *D* scale. This property of the slide-rule forms the basis of special methods of calculation, akin to successive approximation, which will be found very effective for certain types of problems.

Quadratic Equations—In the quadratic equation, $X^2 + pX + q = 0$, it is well known that the product of the two roots is q, and the sum of the two roots is $-p$. If the index of the slide is set at q on the *D* scale of the slide-rule, then any pair of numbers, one on the *D* scale and the other opposite it on the inverted *C* scale (*CI* scale), satisfy the first condition—that is, their product is equal to q. It then remains to move the runner along until a pair of numbers is found whose sum (if q is positive) or difference (if q is negative) is equal to p. Fig. 1 shows the solution of a typical equation.

Not all equations are equally easy to solve by this method. In general, it will be found that those easiest to solve by formula (when the roots are about equal) are most difficult to solve by the above method, and that those most awkward to solve by formula (one root much smaller than the other) are especially easy to solve by the above method.

Cubic Equations, First Type—Cubic equations in which one or the other of the middle terms are missing are frequently encountered. In the case of the general equation $x^3 + ax^2 + bx + c = 0$, the x^2 term may be eliminated by solving for $x + \frac{1}{3}a$ instead of x. The equation then becomes

$$\left(x + \frac{1}{3}a\right)^3 + \frac{3b - a^2}{3}\left(x + \frac{1}{3}a\right) + \frac{2a^3 - 9ab + 27c}{27} = 0.$$

This is an equation of the form $x^3 + px + q = 0$, which may be rewritten as $x(x^2 + p) = -q$. The slide of the slide-rule must be inverted so that the *B* (square) scale and *C* scale read backward. Set the index of the slide at q on the *D* scale. Move the runner along until it comes to where the number on the *B* scale exceeds the number on the *D* scale by p. The value of x will then be found on the *C* scale. All of this is illustrated in the example in Fig. 2. The reason for it is as follows: The two numbers multiplied are the one on the inverted *C* scale (x) and the one on the *D* scale ($x^2 + p$). Opposite x, on the inverted *B* scale, is x^2. This number does not enter into the multiplication but serves to identify $x^3 + p$, which of course exceeds it by the amount p.

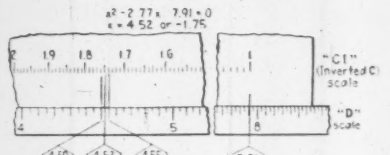


FIG. 1—SOLUTION of quadratic equation, using *D* and *CI* scales of the slide-rule.

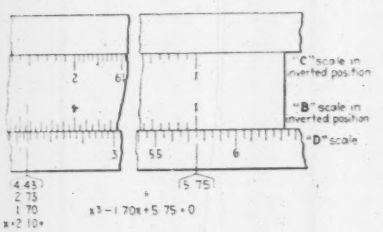


FIG. 2—SOLUTION of cubic equation, using *D* scale and *C* and *B* scales inverted.

Cubic Equations, Second Type—Cubic equations in which the x term is missing are sometimes encountered. For instance, in a beam fixed at one end and hinged at the other, the position of a load measured from the fixed end, to produce a particular reaction at the hinged end, is given by the equation $\left(\frac{x}{L}\right)^3 - 3\left(\frac{x}{L}\right)^2 = -\frac{2R}{P}$. To solve the equation $x^3 + Px^2 + q = 0$, first transform it to read $x^2(x + p) = -q$. The two scales that furnish the key to this solution are the *A* scale (the fixed-square scale) and the inverted *C* scale. Set the index of the slide at q on the *A* scale. The inverted *C* scale has the property of reading the value of x while multiplying by its square. The other factor, $x + p$, will be on the *A* scale. The rule is, therefore, to move the runner to where the number on the *A* scale exceeds the number on the inverted *C* scale by p, the number on the inverted *C* scale being the answer x.

It is of great assistance to have an approximate idea beforehand of the value of the root that is sought. While this may involve quite a little groping around in the case of problems taken at random for exercise, in physical problems this difficulty is not likely to occur. In the equation of the beam fixed at one end mentioned earlier, for example, physical limitations keep the value of $\frac{x}{L}$ between 0 and 1, and furthermore, since the reaction is less than the reaction of a simple beam for all loadings, $\frac{x}{L}$ will always be somewhat greater than $\frac{R}{P}$.

Very close attention should be paid to algebraic signs.

Curious Old Bridge Suggests Hybrid Origin

HISTORY does not relate whether this curious old bridge in southeastern Iowa claims an arch, a truss or a simple beam for ancestry. It has a span of about 14 ft. and the floor system is supported on I-beams spaced 16 in. apart. The cross-beam at midspan may do something to support the curved chords, which appear to have been intended to serve as a superstructure, ac-

SIDE AND END VIEWS of freak bridge in southeastern Iowa.

cording to Prof. F. T. Mavis, of the University of Iowa, who drove over it recently. There are two of these curved members on each side of the roadway; they are made up of bars about 2 in. in diameter.

The general arrangement and the details of the end and diagonal connections of the bridge are shown in the accompanying view.

Reducing Inclined Survey Distances to Horizontal

By J. L. Brubaker
Manhattan, Kansas

THE APPLICATION of the essential horizontal correction factor to inclined measurements in surveying is the most tedious of the series of corrections, which usually include temperature, tape length and catenary. Further, the problem is aggravated in rough country by the more frequent fractional tape lengths and more numerous inclined distances. To provide a rapid and accurate method of obtaining this correction factor for any distance and any difference in elevation between the ends of the incline line, the author has prepared a nomogram that permits the correction to be obtained by the simple process of connecting two points on the diagram by a straight line.

Use of the diagram, shown in the accompanying figure, needs no explanation. Because it is impossible to reproduce a diagram in sufficient size to make it entirely usable, it seems advisable to describe the preparation of the diagram and the method of its construction, so that those who are interested will be able to make one to any desired scale.

The horizontal correction may be computed from the exact equation

$$C = L - \sqrt{L^2 - h^2} \qquad (1)$$

where L is the taped distance between stakes, and h is the difference in elevation. This equation is taken as the basis for constructing nomogram from which the correction C may be read by laying a straight-edge over the given values of L and h and reading the intersection on the C scale.

The equation is first put into the form

$$h^2 - 2LC + C^2 = 0 \qquad (2)$$

which may be put into the third-order determinant form

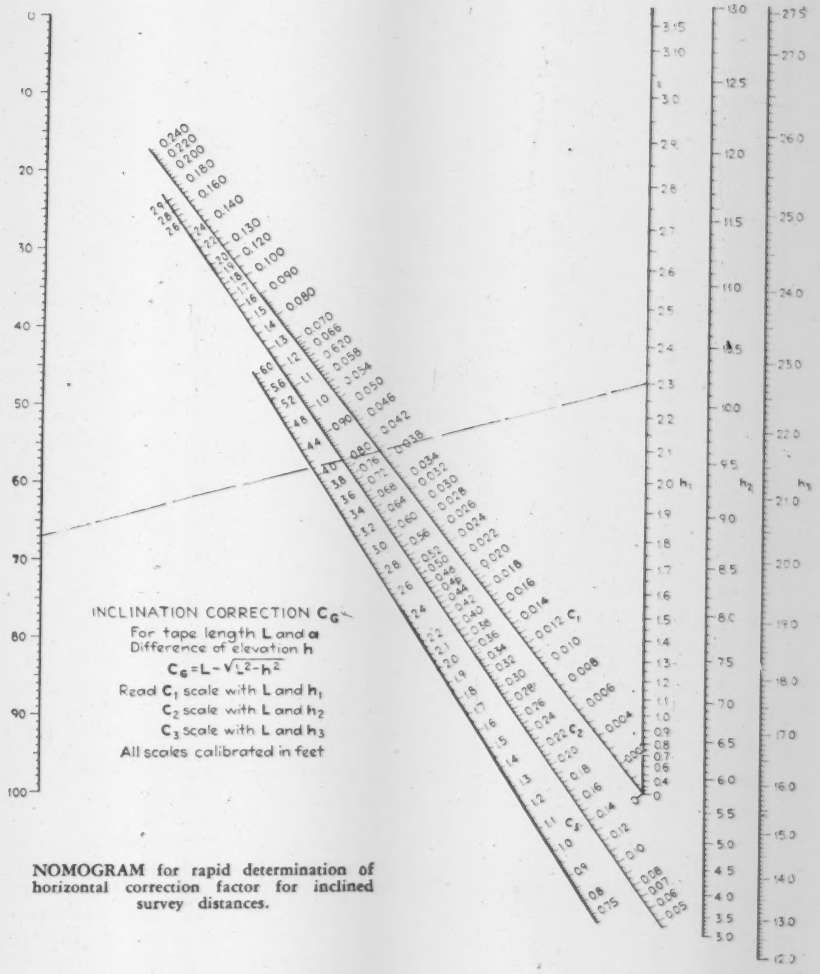
$$\begin{vmatrix} h^2 & 0 & 1 \\ -2L & -1 & 1 \\ \frac{C^2}{1+C} & \frac{C}{1+C} & 1 \end{vmatrix} = 0$$

This gives a diagram which, when plotted on XY axes, consists of a vertical scale of $y = -2L$ on $x = -1$, another vertical scale of $y = h^2$ on $x = 0$, and a curved scale of $y = -\frac{C^2}{1+C}$ and $x = -\frac{C}{1+C}$ between the two vertical scales. This would plot as a very high, very narrow diagram.

To bring the diagram to a more desirable proportion, scale factors must be applied to the h and L scales, letting the C scale change to conform to the new proportions. The determinant form may be rewritten in the symbolic form, first without scale factors, and then with scale factors, as

$$\begin{vmatrix} f_1 & 0 & 1 \\ f_2 & -1 & 1 \\ f_3 & g_3 & 1 \end{vmatrix} = \begin{vmatrix} \mu_1 f_1 & 0 & 1 \\ \mu_2 f_2 & \delta_2(-1) & 1 \\ F_3 & G_3 & 1 \end{vmatrix} = 0$$

where f_1, f_2, f_3 and g_3 stand for h^2, $-$


INCLINATION CORRECTION C_G
For tape length L and a
Difference of elevation h
$C_G = L - \sqrt{L^2 - h^2}$
Read C_1 scale with L and h_1
C_2 scale with L and h_2
C_3 scale with L and h_3
All scales calibrated in feet

NOMOGRAM for rapid determination of horizontal correction factor for inclined survey distances.

$2L_1 - \frac{C^2}{1+C}$ and $-\frac{C}{1+C}$ respectively, and μ_1 and μ_2 are the scale factors applied to scales f_1 and f_2, while δ_2 is the new distance between the parallel scales f_1 and f_2. F_2 and G_2 are the new equations that determine the C scale, and have the following values:

$$F_2 = \frac{\mu_1 \mu_2 f_3}{g_3(\mu_2 - \mu_1) + \mu_2}$$

$$G_2 = \frac{\mu_1 \delta_2 g_3}{g_3(\mu_2 - \mu_1) + \mu_2}$$

To conserve space and make the diagram easier to read, the X axis is made to run diagonally across the page, the Y axis is vertical and coincides with the h_1 scale, the origin being at $C_1 = O$, $h_1 = O$ for the L, C_1, h_1 diagram, but is not shown for the L, C_2, h_2 or L, C_3, h_3 diagrams, although the three X axes all pass through the point $L = O$.

The three sets of C and h scales were used in order to cover a wide range of h without too great crowding at the lower ends of the h scale. This also permits expansion of the C scales.

The constants used on the original nomogram, which is about 20x25 in., are as follows:

For h of	0 to 3′	3′ to 12′	12′ to 27′
μ_2	2	.15	.04
μ_2	.1	.1	.1
δ_2	25	30	35

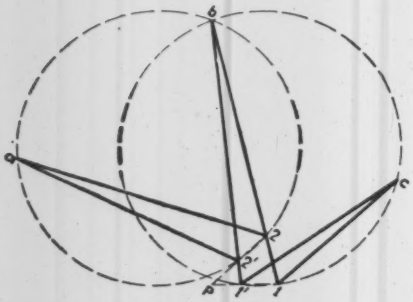
Three-Point Problem Solved by the Cucunutti Method

By J. Maughs Brown
Professor of Civil Engineering, University of South Dakota, Vermilion, S. D.

IN THE YEAR 1592, Sergeant Cucunutti of the Mexican Army devised a useful and simple solution of the so-called three-point problem. While not rigidly accurate for the reason that straight lines are substituted for small arcs, it will give results in the field simply and quickly, and with the required accuracy. If the plane table can be oriented approximately, the result obtained with one trial, using this method, will be accurate. If the preliminary trial orientation is far from correct, then two successive applications of the method will be required, unless the topographer wishes to go to the trouble of erecting perpendiculars and drawing circles with a compass, thereby making the process geometrically correct.

Set up the plane table at the point sought, p, where the three known points can be sighted. Orient the table by guess as closely as possible. Now draw lines through the three plotted points a, b and c by sighting on the three corresponding field points A, B and C. Unless the table is correctly oriented, the three lines so drawn will not meet at a point, provided also the table is not set up over the great circle through the three given points. Mark the intersection of the lines from b and c, point 1, and the intersection of the lines from a and b, point 2. Now loosen the horizontal motion of the table and turn the board through a small angle. Repeat the first process, marking the second set of points 1′ and 2′. Draw lines through 1-1′, and 2-2′. The intersection of these short lines is the point sought.

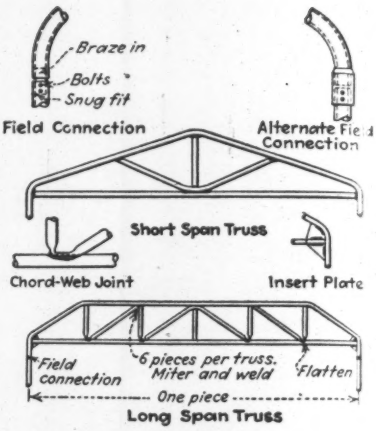
As the point sought is on the circle passing through its position and a b, and also on the circle passing through its position and b c, it is at the intersection of the two circles. As changing the orientation of the table does not change the angles laid off by the alidade, the intersection of any pair of lines drawn from a and b will be on the circle p a b. Likewise any pair of lines drawn from b c will be on the circle p b c. By finding two such intersections on each of points, two points on each of the circles going through the point sought are found. As these points should be close together, one can use straight lines instead of arcs to find the point of intersection of the circles, which is the point sought. Noting visually in which direction the circles should turn, a very close spotting of the intersection can be made. A small French curve can be used, but this is hardly necessary.



THE CUCUNUTTI METHOD of solving the three-point problem. This drawing is distorted to simplify the explanation. In practice point p will fall close to the intersection of the circles.

Light Welded Trusses Made With Second-hand Pipe

OIL-FIELD ENGINEERS have for many years made ingenious use of welded second-hand pipe for light building framing. Contractors also have utilized such construction for field buildings, although not widely. Suggestions for the design of oxy-acetylene welded roof trusses made out of second-hand pipe are given in the October issue of *Oxy-Acetylene Tips*. These suggestions for both a short and a relatively long span truss are given in the accompanying sketch. In both the designs it will be noted that the entire top chord is made from one piece of pipe, although shorter lengths joined by butt welds would be as satisfactory. The field connection at either end of the truss to the supporting column is made by a short section of splicing pipe as shown. The connection of the web members to the top chord in the short-span truss is made by welding a simple straight bevel cut.



TYPICAL DESIGNS of light welded trusses made from second-hand pipe.

For the longer span, truss splices in the bottom chord, if used, should be made with a splicing sleeve. The vertical and inclined web members may be made in one piece as shown. For such a detail the pipe is flattened after being bent to fit the surface of the bottom chord. In all cases the centers of gravity of the web and chord members should meet at a single point.

Ventilating Pipes in Tunnel Support Electric Wires

IN SOME of the tunnels on the Colorado River Aqueduct, being built by the Los Angeles Metropolitan

ELECTRIC WIRES supported beneath ventilating pipe are out of the way and well protected.

Water District, wires for electric lighting are carried on the under side of the steel ventilating pipe, where there is convenient means of supporting them in a protected location.

Insulators that support the wires are fastened to the ventilating pipe by means of a metal ribbon or band encircling the pipe and having its two ends bolted together on top of the pipe. The two porcelain insulators are bolted to the band at the desired location before the band is placed around the pipe.

The accompanying photograph was taken at the entrance to the tunnel where the ventilating pipe is supported on welded steel frames. This steel support is used only at the tunnel entrance, of course; in the tunnel the ventilating pipe is hung from tunnel timbering in the usual way.

Letters to the Editor

Expansion of Continuous Concrete Girders

Sir—Measurements of the expansion of the superstructure of the continuous concrete-girder bridge at Marysville, Kan. (*ENR*, Jan. 25, 1934, p. 110) have been made on two occasions; one of these, made during a period of about the coldest weather, and the other during the extremely hot period that prevailed this summer have revealed some interesting facts. Readings of the apparent expansion were taken at the floor-expansion devices and also down at the rockers. At the west end of the bridge the measurements indicated an expansion of 1¼ in. over a length of 280 ft. The expansion indicated at the east end was ⅛ in. over the remaining length of 170 ft.

There was no great difference between the readings taken at the various points across the roadway floor-expansion device and at the rockers. The apparent rate of expansion per foot was therefore 6½ per cent greater over the length of 170 ft. than over the length of 280 ft.

It is quite possible that this discrepancy could be caused by slight movements of the abutments even though they are founded upon rock. They are quite high, and a very slight rotation of the base would cause appreciable movement at the bridge seat.

Assuming a coefficient of expansion of 0.0000067 for concrete, the measurements indicated a change in temperature of 59½ deg. F. over the 170-ft. length, and a change of 55½ deg. F. over the length of 280 ft., as compared with an 89-deg. change in average atmospheric temperature.

Although there were a number of fine cracks that appeared in the curbs and occasionally in the floor slabs immediately after the construction of the bridge, these cracks do not appear to be increasing in size or number since the bridge has been open to traffic. The cracks are mostly in the region of high negative moment, and none of them is large enough to permit inserting the point of a penknife blade in them. We have found it possible to reduce this cracking greatly, if not to eliminate it entirely, by placing the concrete of the curbs and handrails after the falsework has been released under the girders.

It is hardly possible, however, to eliminate entirely the very fine hair cracks in the floor slabs since they apparently are due to concrete shrinkage.

We are also planning to record precise levels of the floor of the bridge at intervals during the next few years, to discover whether there is any evidence of plastic flow.

LAMOTTE GROVER,
Office Bridge Engineer,
State Highway Comm. of Kan.

Topeka, Kan.,
Oct. 23, 1934.

Federal Contract Exactions

Sir—The very interesting articles, "Advice for Contractors Entering Government Work," contributed by Howard Jones, appearing in your recent issues, not only deserve high praise for their conciseness and clarity but for the effort made by the author to point out some of the pitfalls to be encountered when assuming the obligations of a construction contract with the federal government.

To those of us who have been engaged in building construction both before and during the period of extensive activity in the government building program but who have not as yet engaged in this program, either through inability to compete on a price basis or because of the type and number of competitors for these contracts, the reason for the unusually large percentage of failures on this work is quite obvious. We have known for some time that this work, especially jobs costing less than a million dollars, has been let at very low prices (many of us believe, below cost), which is inevitable when the number of competitors is not restricted and when prequalification is not considered. It would be interesting to know to what extent the various unfair and arbitrary rulings of the government have contributed to the cause of these failures.

Compare these rulings with the accepted customs of the building industry prevalent in private work, and it would seem that a dangerous precedent is being established which might cause great hardships to contractors engaged in private work for many years to come.

We are fully aware of the tendency during the past fifteen years to increase our responsibility in assuming the mistakes of others; and a great many of the contracts we have been forced to sign (that is, if we wanted to continue in the business) have gone a great way in breaking down the spirit of mutual confidence and close cooperation between all parties. But most of us relied upon the fairness of our clients and architects to consider the intent as well as the technicalities of the contract, and in most cases satisfactory results have been obtained. Contractors feel, however, that the one and practically the only obligation of the owner is to pay for the work, subject, of course, to the stipulated conditions; failure to do so should constitute a breach of contract, entitling the contractors to collect damages in full. To take away this right, as certain rulings of the government seem to have done, because of lack of appropriations or for other reasons not within the control of the contractor, is simply confiscatory and un-American.

Unless a real concerted effort is made by our industry to obtain fair and impartial treatment from the government, a government contract will always be a hazard and perhaps a greater menace than unfair or incompetent competition.

VICTOR T. NYDELE,
Nydele Building Construction Co.

Chicago, Ill.,
Dec. 20, 1934.

Fire-Resistive Structures

Sir—In your Dec. 20 issue there is an editorial comment on the fire in the Kerns Hotel at Lansing, Mich., which at the end says, "Question: Are we overbuilt?"

There would be no question but that we are overbuilt, and decidedly so, on this type of structure which is built of highly fire-resistive exterior walls and highly inflammable interior construction. The brick manufacturer would probably be the first to condemn the old, so-called "masonry" construction, which provides for fire-resistive construction on the exterior only and permits beam and joist construction and wooden partitions on the interior.

If education is a matter of information, then the information available from the recurrence of such disastrous fires as have occurred in this type of construction during the last decade should very definitely eliminate further building construction. It should also lead to the demolition of all buildings of this type that cannot be readily converted into relatively fine-resistive construction by renovizing.

E. F. GALLAGHER,
Manager-Engineer,
The Brick Manufacturers Association.

Worcester, Mass.,
Dec. 26, 1934.

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EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, N. A. Bowers, W. G. Bowman, W. W. DeBerard, F. W. Herring, C. S. Hill, H. W. Richardson, J. I. Ballard.

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January 10, 1935

Transport Regulation Difficulties

DEFINITE PROSPECT of joint regulation of all transportation agencies was held out by the President in the message with which he opened the 74th Congress. There is no disagreement as to the need for such regulation; it is an ideal that has long been a practical necessity. At the same time the difficulties of the problem are many. Diverse jurisdictions, the "railroadmindedness" often charged against existing federal regulation, the obstacles in the way of imposing waterway tolls in view of the ancient tradition that navigation should be free, are some of the conflicting features of the problem. Coordinated regulation has no meaning or virtue except as it brings out the best functioning of each separate agency, so that traffic will go where it can be best served—to rail, plane, bus or ship—and the public will thus obtain the advantage of the inherent economies and service qualities of all. That, however, is not an easy thing to accomplish, especially if the wish to hamstring the competitors of the railroads opposes the desire to give the public best transport service. Fairly established regulation of all agencies is the end to be sought, but whether in view of present conflicts it should be entrusted to a single body is a question not yet cleared up.

Power Planning

ANOTHER ELEMENT of a national development plan is soon to to available in the preliminary report of the National Power Survey, a study carried forward by the Federal Power Commission at the request of Congress. The study has been directed toward a determination of both existing and potential sources of power, load centers, future markets, and production and distribution costs. The study includes the first nationwide survey of the cost of distributing electricity—the chief bone of contention in rate determinations. Heretofore studies of present and potential sources of power in this country, other than a few regional studies, have been very superficial. The present one, therefore, should be of material advantage in coordinating present facilities and in developing new power sources. As it includes steam and oil-engine generation of power as well as water power, the study, if conducted in an unbiased manner, should explode some of the current fallacies concerning the low cost of *any* water power, especially when far removed from the centers of population.

Law and Road Taxes

LEGAL ACTION against gasoline-tax diversion by executive order has been rather strangely neglected. As indicated in the article on p. 43, the courts, when appealed to, have quite generally found the provisions of the law assigning motor-vehicle tax money to highway improvement sufficiently explicit to justify decisions against diversion. In many states where the tax law by its [illegible] leaves openings for diversion by fiat, other constitutional or statutory limitations have been found effective bulwarks against these tax-law weaknesses. Altogether a case in law against diversion of motor-vehicle taxes has a fairly certain chance of success if all the resources of the law are brought into action. Why then has not this defense against diversion been more generally invoked? The answer is, partly ignorance of its possibilities, partly lack of funds to meet the cost, but also in large degree fear that action will bring reprisals from executives and legislatures. The effectiveness of these obstacles has been the greater because of disorganization of the roadbuilding industry, which shows little spirit in consolidating and coordinating its forces. Until highway transportation interests act in a coordinated way, and go after road-improvement funds instead of waiting for them to be handed out, they will continue to suffer the yearly uncertainty that now prevails over whether planned highway development will go forward.

More Rational Use

MORE RATIONAL UTILIZATION of timber as a material of construction will be the ultimate result of the numerous modern innovations in the field, supported by research studies in the laboratory. Despite the well-recognized advantages of wood for structural service, there was a lag of many years in the technical study and development of its utilization, as compared to the elaborate scientific research carried out on other materials. The development and improvement of plywood are recent advances, and the introduction of connector rings in this country from Germany is another. A study outlined in this issue combined these two devices in an investigation of the possibilities of plywood gusset plates fastened by ring connectors for use in joints, where timber framing is most obviously weak. This type of thinking and study directed toward the effectiveness of the use of timber, when combined with corresponding field advance, will clear the way to wider and more rational use of this old and worthy material.

Public Water Resources

THE MOST SIGNIFICANT ASPECT of the history of the Society for Establishing Useful Manufactures, as set forth on another page in this issue, is that devoted to the difficulties experienced by growing communities in breaking the stranglehold of private domination of water resources. In the absence of statutory provision for public supervision and control of potential water-supply sources, it is difficult if not impossible for developing communities to meet their ever-increasing needs. This consideration gives point to the proposal recently made by the New Jersey State Water Policy Commission that there be established in that state a Water Authority authorized to provide joint-supply projects for groups of communities. Similar efforts in the past have proved ineffective because of inadequate legal and financial powers to acquire the necessary sources. But an authority as contemplated by the policy commission, if established by the legislature, may also find its efforts completely abortive if it is not endowed with proper powers to control in reasonable manner for public use the natural water resources.

The President Calls on Construction

IN THE LIGHT of the President's history-making message to Congress on the state of the union, it is imperative to give early thought to the new recovery plan which he outlined. Even in the absence of details his general statement marks out definite obligations. The chief obligation rests on construction, for the heart of the message is a call on construction to lead the way to recovery.

To look for a moment at the spirit of the message: For the first time the claim of every able-bodied citizen to employment by which he may win his livelihood in return for adequate service is recognized. It is immaterial at present whether the President meant to assert it as an inherent human right; the important fact is that he declared employment of the idle to be necessary to national economic recovery. And, again for the first time, construction is designated as the means that is to provide the lacking employment.

When the President announced that *"The federal government must and shall quit this business of relief,"* he gave voice to a conviction that has become universal. Experience has awakened a deep feeling of alarm over the dole plan of carrying on. Out of this feeling in turn has grown the realization that anything other than a constructive work system is not only sterile as a recovery aid but, in the President's words, is "a subtle destroyer of the human spirit."

A SIGNIFICANT CODE of principles and an indication of types of work to be built accompanied the announcement of the plan.

The aim is to re-employ three and one-half million men during the next fiscal year, and to taper off the program as fast as men are re-absorbed by private business. Projects are to be chosen that will be useful, will create future new wealth, will provide a large percentage of direct labor, will return the government's expenditure—a timely restatement of the self-liquidation principle—and will compete as little as possible with private enterprise. The projects are to be distributed according to employment needs. A "security wage" is to be paid, larger than a relief dole but less than that of private employment.

These are excellent principles. If not misinterpreted in application, they will go far toward assuring full success. But the pitfalls of misinterpretation need to be guarded against. If the objective of creating future wealth is made an excuse for choosing visionary projects, if the desire to provide as much direct labor as possible misleads the administration into embracing the hand-labor fallacy, if bookkeepers and tailors are set to trenching or concrete-placing, if the aid that can be obtained through the skill and managerial ability of contracting organizations is overlooked or disdained, the recovery objective is likely to be set back instead of furthered.

THE TYPES OF WORKS indicated by the President include normal local and federal improvements, but also some highly important new classes. Grade-crossing elimination is specially mentioned, and this brings the gratifying news that the badly needed work of removing the danger of unsafe crossings is at last to be utilized for recovery. Vast amounts of grade-crossing work are known to be ready to go at once. On the other hand, such new and strange undertakings as rural housing and rural electrification are undoubtedly far from ready to start quickly—on any stable, defensible basis. In soil-erosion prevention and in reforestation there are definite possibilities for a quick start. But two fields above all offer prime possibilities for a rapid beginning: the necessary improvement works of local communities, and highway building.

In adapting these types of works most wisely to the re-employment and recovery purpose there lie some of the major early problems of the plan. Let us bear in mind the plain meaning of the President's declaration. The contemplated work is not to be relief, but is to take the place of relief. Nor is it to be idle work-relief. Nor, again, is it to be a sterile employment undertaking carried on in such a way as to paralyze private activity or put its men and tools on the shelf to rust. But it can become all these things through shortsighted action.

THE PLAN presents a more difficult problem than anything the government has yet undertaken in the course of its recovery efforts. Sound procedure and unprecedented speed are vital, and the problem of assuring these is a challenge to the highest power of government organization, for the work must be so conducted that the country's whole organism will be drawn into action to sustain the rehabilitating effect of the employment itself. If the program fails to enlist contractors, engineers, builders of machines, and in sequence the entire range of capital-goods industry, the mere creation of a short-lived solvency and purchasing power can have no lasting effect.

It is evident that very close interaction of the government's agencies and of the construction industry is a first requisite. One need only think back to the days of the CWA to realize that, however revised and altered from leaf-raking to works of permanence, such unorganized, catch-all employment has no value for recovery; it remains the empty relief which the President mentioned with proper scorn. From any standpoint but that of sawbuck charity the success of the plan will be measured by the fullness with which it draws into its system the existing art and organization of the construction industry. The program therefore is a great challenge to construction. It is a test of what unity of action can contribute to the new national purpose.

THE CONSTRUCTION INDUSTRY can be of essential service in assuring readiness for quick execution of projects. It can give valuable counsel on contract forms and procedures. It can aid in effective mobilization of working forces, contribute efficient management methods, make provision for quick procurement of materials and tools. The construction code, far from standing in the way, can be of added service; its joint labor-industry boards can lead in the adjustment of wages and working conditions for best adaptation to the purpose of the program.

In the degree to which the newly integrated construction industry is able to make its resources fully available to the government's construction-recovery plan lies the key to the success of the gigantic undertaking. Government as well as industry is put to the test. It is their joint task to attain the harmony of action without which the program cannot be fully effective.

CURRENT NEWS

President's Message Insures Continuance Of Public Works

PRESIDENT ROOSEVELT'S annual message to Congress, delivered on Jan. 4, establishes public works and relief work as the basis for the Administration's program for the next fiscal year to re-employ the 3,500,000 who are now on relief rolls. He stated that "The Federal Government must and shall quit this business of relief." The message was phrased in general terms as to the type and plan of works to be undertaken, although it accepted the plan established by the National Resources Board for guidance in this program, and made no reference to the fund to be requested for Congressional appropriation to carry forward the work. The subsequent budget message delivered Jan. 7 is reported in another column on this page.

After dismissing the dole as "a narcotic, a suble destroyer of the human spirit," President Roosevelt proceeded to outline a program of works to be undertaken by the federal government as "the only governmental agency with sufficient power and credit to meet the present situation." The unemployment figure which the President quoted frequently was 3,500,000, which he believed necessary to provide for in work relief programs "pending their absorption in the rising tide of private employment."

Centralized authority

Before outlining his plan for the program of works, the President recommended that all emergency public works be united into a single new and greatly enlarged plan. The new organization "will be charged with the orderly liquidation of our present relief activities and the substitution of a national chart for the giving of work."

The new program of re-employment through public works, as indicated by the President, is to be controlled by the following principles:

1. All work undertaken should be useful—not just for a day, or a year, but useful in the sense that it affords permanent improvement in living conditions or that it creates future new wealth for the nation.

2. Compensation on emergency public projects should be in the form of security payments which should be larger than the amount now received as a relief dole, but at the same time not so large as to encourage the rejection of opportunities for private employment or the leaving of private employment to engage in government work.

3. Projects should be undertaken on which a large percentage of direct labor can be used.

4. Preference should be given to those projects which will be self-liquidating in the sense that there is a reasonable expectation that the government will get its money back at some future time.

5. The projects undertaken should be

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FHA Modernization Activity Produces $200,000,000 of Work

The modernization program sponsored by the Federal Housing Administration has resulted in the spending or contracting for more than $200,000,000 of modernization and repair work since Aug. 1. This work is being reported at a rate varying from $10,000,000 to $15,000,000 per week, and the FHA estimates that at least 300,000 men have been put to work by the program. A particularly important feature of the work is that the program involves a relatively insignificant expenditure on the part of the federal government.

Contract of $3,117,518 Awarded For Gallipolis Dam on Ohio

The low bid of $3,117,518 presented by the Dravo Contracting Co., Pittsburgh, for the construction of the Gallipolis dam on the Ohio River, has been approved by the chief of engineers. Although the bid of the Dravo organization was the lowest received for constructing this dam, it was higher than the reported engineers' estimate of $2,422,491.

This structure is notable as being the first dam on the Ohio River to use roller gates similar to the type used on the Kanawha River for navigation improvement projects. The roller gates on the present structure will be 125 ft. long as compared to the length of 100 ft. used on the Kanawha dams.

Break in Large Water Main Causes Damage in New York

A break in a 48-in. water main in New York City at about 5:30 a.m. on Jan. 4 resulted in the flooding of several blocks of upper Manhattan and caused considerable inconvenience to the residents before the broken section could be isolated and service restored.

At the point where the break occurred, 135th St. and Convent Ave., there is a gate house built over the southern end of the Croton Aqueducts. Twelve 48-in. cast-iron mains take off from it to the south, eight under Convent Ave. on the east and four under Amsterdam Ave. on the west. Of the eight mains on the east, one had been changed some years ago from low service to intermediate service by being extended around the gate house and northward to the 179th St. pumping station. It was on this main that the break occurred, in a short dead-end stub that had been abandoned but still kept under pressure when the service change was made.

To stop the flow through the broken section it was necessary to shut down all eight mains, and this was completed just before 1 p.m. The mains were then again put under pressure one by one until the broken section was located. By 2 p.m. all but the broken one were back in service. During this time Catskill water had been turned into those areas most adversely affected, by opening boundary gates.

Budget Proposes $4,000,000,000 for Work Relief Program

THE BUDGET message of President Roosevelt, presented to Congress Jan. 7, contains a proposal for an appropriation of about $4,000,000,000 for the new work-relief program outlined by the President in his annual message presented Jan. 4. The proposal of the President provides that this appropriation be unallocated as to type of work and geographical distribution, allowing him to allot the fund. The total budget figure indicated by the message was $8,520,413,609, which, according to estimates of the national revenue for the next fiscal year, will result in a deficit of $4,528,000,000.

President Roosevelt requested that the present fund of about $900,000,000 available from the unobligated portion of previous appropriations be made available immediately by Congress for transfer to the emergency relief needs for the remaining months of the current fiscal year. The present fund for relief will be completely exhausted early in February.

Budget items

Estimates taken from the annual report of the Treasury Department for the coming fiscal year, which is assumed to correspond to the budget estimate figures of President Roosevelt, contain the following items: Financing for the Tennessee Valley Authority and the Boulder Canyon project has been removed from the status of emergency funds and placed in the classification of regular expenditures for the coming year. The list of emergency expenditures does not include any provision for the Civil Works Administration or the F.E.R.A. The Federal Housing Administration figure for the coming year is $27,604,525.

The figure of $3,900,000,000 for "relief of unemployment" appearing under the emergency classification is not subdivided and this fund would be expended under the immediate direction of the President, according to his request in the budget message.

Ceremony Starts Construction On Muskingum Project

The first shovel of dirt marking the official start of construction operations on the $34,000,000 Muskingum Watershed Conservancy District project was turned Jan. 3 by Governor White of Ohio. This ceremony started work on the Tappan Dam, an earth-fill structure located about 10 miles southeast of Dennison, Ohio.

Bids on the construction of another unit of the program, the Clendening Dam, will be opened in Zanesville Jan. 29. The engineer's estimate of this dam is about $750,000. Relocation work for 80 miles of railroad in the district which must be moved out of the various reservoir sites is scheduled to begin soon.

Chicago Sanitary District Reports Construction Progress to Supreme Court

IN the semi-annual report to the Supreme Court of progress of the Sanitary District of Chicago rendered in accordance with the 1930 decree requiring a certain schedule by which it will be possible to reduce the diversion of Lake Michigan water to 1,500 sec.ft. by 1938 it is stated that some $5,500,000 has been expended on construction in the six months ending Dec. 31, 1934. This money has come out of the $42,000,000 PWA loan and grant. Since the PWA agreement was made, on Dec. 16, 1933, construction work has been resumed or started on nineteen contracts which will cost $15,500,000. Bids have been received for three other contracts for $2,800,000. Plans will be completed within two months for two more contracts representing $6,100,000, making a total of $24,400,000 to come out of the total PWA sum. Completed work on sewage treatment as of Dec. 1 amounts to $107,700,000. Low construction prices, designs for smaller ultimate capacity than originally planned and late developments in the sludge dewatering and incinerating process have necessitated a new estimate of the entire Southwest Side Project. This restudy indicates a saving of $7,500,000 on the entire program, which now comes to $105,900,000 yet to be built.

Construction on the Calumet project contracts is essentially 75 per cent complete. Plans for the sludge dewatering and incinerator plant were delayed pending a review and report requested by PWA as to the relative merits and costs of (1) digestion and disposal on sand drying beds, (2) pumping sludge to the Southwest Side plant and disposal there by dewatering and incineration and (3) dewatering and incineration at Calumet site by three alternates. Plans are being rushed on the third method to receive bids early in 1935 and the entire project is expected to be ready for operation by early fall in 1935.

On the West Side project completion of the Imhoff tanks (Battery C) and eight sewer contracts are expected to be complete by the end of 1935.

On the West-Southwest treatment plant progress has not been as good as was estimated in the last semi-annual report. The report states that this has been due to PWA investigations, reviews and conferences with the sanitary district engineers, finally resulting in complete accord in August.

Experimental work

The development of the process of dewatering and incineration of sludge and the experimental plant at the West Side treatment works progressed to a point where it has been found to be feasible to combine steam generation with sludge incineration to produce the power necessary to operate the entire plant more economically than by purchasing electrical energy. On Nov. 10, 1934, approval was given for the design of steam turbine-driven pumps and blowers, though it has not as yet been obtained for the incineration process for the disposal of sludge. Definite approval awaits further development of the process in actual operation at the new Calumet plant.

Bids were received Dec. 27 on 8,100 ft. of 18-ft. sewer in the Southwest Side project. Four sections of the sewer (75 per cent of the total work) will be under contract by June, 1935, and the remainder by the end of the year, long before the new Southwest treatment works can receive sewage.

The packers in the stock yards have at last granted permission to the district's engineers to inspect the various plants, and to measure and sample the flow. Details of the survey are now being worked out with representatives of the packing interests.

Washington Monument Cleaned And Scaffolding Being Removed

The overhauling and cleaning of the Washington Monument was completed on Jan. 2, and on that day the work of removing the 555-ft. steel scaffolding was started. The work of removing the 600 tons of steel material in the scaffolding will require about three weeks. The design and erection of the scaffolding was described in *ENR*, Dec. 20, 1934, p. 779.

The cost figures for this work, released by the National Park Service, which was in charge of the operations, indicate: $69,000 for erection, maintenance and demolition of the scaffolding and about $17,000 for the actual repair work, including the cleaning operations. Erection and dismantling of the scaffold required about 19,300 man-hours.

Newest addition to the Rockefeller Center group, the Italian Building, is rising to 40-odd stories opposite famous St. Patrick's Cathedral on Fifth Ave. John Lowry, Inc., is the general contractor. To the left is the towering RCA building which dominates the Rockefeller Center development. Directly behind the Italian Building, in the shadows, is the Music Hall Theater, backed up by the RKO office building. In the front of the RCA Building, but not shown here, are the British and French Buildings, low structures facing on Fifth Ave. To the left of the RCA Building, and also out of sight, is the Center Theater Building, completing the development in its present stage. More buildings are planned for the project in the future.

ITALIAN BUILDING RISING IN ROCKEFELLER CENTER GROUP

Improved Compliance In Construction Noted By Authority

IMPROVEMENT in compliance with the provisions of the construction code was noted by the executive committee of the Construction Code Authority at its meeting held in Washington Jan. 4. Satisfaction was expressed with the new NRA procedure whereby hearings by compliance boards on alleged violations are being decentralized to regional offices. NRA has defined the territory within the jurisdiction of each region and designated all but a few of the regional directors. Action on compliance procedure has been appreciably speeded up.

Code officials are further encouraged by the action of the New Orleans Public Belt Railroad Commission, acting on recommendation of the government contracts branch of the compliance division of NRA, in rejecting the low bid on the lighting system for the Mississippi River bridge because of failure to file a duplicate bid in the bid depository established under the electrical contractors' chapter. Under the circumstances the awarding authority desired to reject all bids and re-advertise, and NRA issued an administrative order relieving the bidders of the code requirement not to re-submit bids within ninety days from the rejection of bids, in order that the project might not be unduly delayed.

More area agreements

Announcement has been made of the approval of additional area agreements under the construction code fixing wage, hour and other working conditions for specific divisions in specified areas. Only ten such agreements have been approved to date, although several hundred have been filed; public hearings have been held on fifty. Six of the ten area agreements approved involve the painting, paperhanging and decorating division. However, this division desires to stabilize wage rates more quickly than through the time-consuming procedure of area agreements and has presented to NRA proposed amendments to its chapter of the code to establish minimum rates for skilled labor according to a sliding scale beginning at 60c. per hour and running to $1.00 per hour in trading areas of various populations. Public hearing on these amendments has been scheduled for Jan. 24 in Washington.

The executive committee of the Construction Code Authority received the report of the special committee authorized at the meeting in Knoxville, Dec. 7, to review and decide certain controversies between the general contractors and mason contractors divisional code authorities involving payment of assessments and proposed amendment to the definition of the mason contractors chapter. An amendment to the code suggested by this special committee, to establish the recommended procedure as to assessments, will come before the Construction Code Authority at its meeting to be held in Washington Jan. 25.

Two new chapters

Two additional chapters have been added to the construction code by the recent approval of Chapter XXIII for the construction news service division (Dec. 20), and the approval of Chapter XXI for the stone setting contractors division (Dec. 31). This brings the total of approved chapters to twenty-one. Reports indicate further progress on the sub-chapters of the general contractors' division covering respectively building contractors, heavy and railroad contractors and highway contractors. The sub-chapter for the latter was reported to be pending final approval. The architects' chapter, likewise, is far advanced toward approval, but the proposed chapter for engineers is dormant.

A public hearing was held on Jan. 3 on a petition from the metal furring and lathing contractors against their inclusion under Chapter XX for the plastering and lathing division. This latter chapter was approved June 27, 1934, and within the ten day period provided for automatic exemption, the members of the National Association of Metal Furring and Lathing Contractors applied for exemption. The public hearing was scheduled to determine whether or not this exemption should be made permanent.

PWA Requires Contract Work on Twin Cities Sewerage Project

Contract work must be used as the basis for carrying forward Minneapolis' share of the construction operations on the Minneapolis-St. Paul sewage disposal project, according to an order issued by the state PWA engineer, William N. Carey. This order was transmitted to the engineer in charge of the Minneapolis part of the work, in the form of a letter from Mr. Carey stating that the next section of the work, a length of intercepting sewer in north Minneapolis, must be awarded by contract.

The letter, according to a press quotation, stated:

"I have today been directed to advise you that the administrator does not approve award of Contract 303 by city force account as recommended by your city council.

"His decision is solely that all future work must be let to the lowest responsible bidder in full and free competition and that he will not now approve of any additional sections of this work being done by the force account method."

Bills of Interest To Construction Appear in Congress

ALLOCATION of one-third of all federal aid highway construction funds for improvement and construction of roads used as rural-free delivery routes and star-mail routes is sought in a bill introduced in the House by Representative Tarver of Georgia. The federal aid money set aside would be apportioned among the states in the ratio which the mileage of rural-free delivery and star-mail routes in each state at the close of the next preceding fiscal year bears to the total mileage of such routes in all states.

Construction of works for flood control and improvement of navigation in the Congaree, Santee and Cooper River Basins in South Carolina would be provided by a bill introduced in the House by Representative Fulmer of that state. The work would be placed under the jurisdiction of the Secretary of the Interior. A sum not to exceed $10,000,000 would be provided to carry out the work.

Construction and operation of underground pneumatic tubes for transportation of mails between the general Post Office at Brooklyn, N. Y. and Floyd Bennett Field (New York City's principal airport) is provided for in a bill introduced in the House by Representative Rudd of New York. The tubes would also connect with the five postal stations between these two points paralleling Flatbush Avenue. The work would be paid for from unappropriated funds of the Post Office Department.

Authority for the Administrator of Public Works to make loans to local posts or units of any veterans' organization for the repair or construction of quarters would be provided for in a bill introduced in the House by Representative McCormack of Massachusetts.

Appointment of a commission to determine the necessary clear height from the water of the superstructure of the proposed bridge across the Hudson River at 57th Street, New York City, is provided for in a bill that has been introduced in the House by Representative Kenney of New Jersey.

Chief of Engineers Report Approves River and Harbor Work of $155,000,000

THE ANNUAL REPORT of Major General E. M. Markham, chief of engineers, U. S. Army, proposes a program of river and harbor improvement which would require an appropriation of $155,000,000. The report was rendered to Secretary Dern and will be the basis for Congressional action. Subdivided into the three major divisions, the report includes: projects authorized by the PWA, $93,816,610; maintenance and improvement work authorized by Congress, $47,164,115; and flood control work, $29,906,768. The total of this work is about $170,887,000, but funds aggregating $14,000,000 remain unexpended from past appropriations, requiring new appropriations of about $155,000,000 to carry out the suggested program. About half of the aggregate total of expenditures proposed would be used in the development of the national system of inland waterways.

Among the larger individual items contained in the report are: Bonneville dam, Columbia River, $8,400,000; upper Mississippi River between the mouth of the Missouri River and Minneapolis, $35,000,000; Missouri River between Kansas City and Sioux City, $15,974,000; Fort Peck dam, $20,000,000; Tygart dam, West Virginia, $2,000,000; Mississippi River between the Ohio and the Missouri Rivers, $2,200,000; Cape Cod canals, $3,000,000, and Delaware River, $3,150,000.

Power Commission To Report Survey Of Power Resources

THE Federal Power Commission, in its annual report to Congress, states that it will submit the preliminary report on its national power survey some time this month and will submit a final report in June. The report will include the electric rate survey authorized by a joint resolution of Congress and upon which a staff of engineers, accountants, rate experts and field agents have been at work since June, 1934. The national power survey was authorized by the President in August, 1933.

Potential power sites are being classified with reference to capacity, cost, and accessibility to market to determine how and in what order they can be economically developed by public or private enterprise. A determination is being made, by districts, of the relation between generating capacity of existing power plants and the demand for electricity that will exist when normal industrial activity is resumed and the purchasing power of consumers is restored. Rural electrification is being studied primarily in its bearing upon the nation's present and future power requirements.

"Water-power development," states the report, "while the major objective because of the government's vital interest in the conservation and utilization of this natural resource, is by no means the sole element. A proper combination of steam-electric and hydro-electric generation furnishes generally not only the most dependable but also the cheapest source of electrical energy. Establishing and maintaining that balance between steam and hydro-electric power which will give the United States the most dependable sources of energy at the lowest possible rates is, therefore, one of the principal objectives. At the same time proper consideration is being given to the possibilities of diesel and other internal-combustion engines, particularly as they relate to the problems of isolated communities. Natural gas is also entering largely into the picture, competing not only with coal and artificial gas but also with electricity as a source of heat and energy. All these factors must be taken into account."

The Power Commission states that it has received 30 new applications for preliminary permits for licenses for power projects or transmission lines during the fiscal year, making a total of 1,276 applications received during the 14 years of the commission's existence. To prevent squatting on power sites by promoters or power companies for speculative or obstructive purposes, the commission states that it has broadened the scope of its investigations of applications for preliminary permits, requiring a satisfactory showing as to the financial ability, available market and good faith intention to construct each project. In furtherance of the President's recovery program, it states, in cases where active work has been postponed or delayed, licensees are required to show cause why construction has not been pursued diligently and applications to extend the time for beginning construction are denied except upon clear and convincing proof that such extension will serve the public interest.

Edward Wegmann Dies; Authority On Dam Design

Edward Wegmann, for more than 30 years in the engineering service of New York City and in private consulting practice since 1914, and author of the well known volume on "The Design and Construction of Dams," died in New York on Jan. 3 at the age of 84. His unusually long career in the field of water supply engineering and dam design, beginning with his appointment to the Aqueduct Commission of New York City in 1884, has made his name well known in the civil engineering field for many years.

Edward Wegmann

Mr. Wegmann was born in Rio de Janeiro, Brazil, Nov. 27, 1850, of Swiss parentage. His early education was in the public schools of Switzerland followed by two years in Brooklyn Polytechnic Institute (1866-68). He received the degree of civil engineer from New York University in 1871.

Immediately after graduation Mr. Wegmann went into railroad work, serving as rodman on construction operations of the New Haven, Middletown and Willimantic Railroad (New York and Boston Air Line) in 1873, and as assistant engineer on the same line the following year in charge of bridge construction across the Connecticut River at Middletown.

In 1874 Mr. Wegmann was with the Wyandotte Rolling Mills in Michigan and the following year formed a partnership with Robert Creuzbaur, Brooklyn, to manufacture steam engines under patents held by Mr. Creuzbaur. Returning to the civil engineering field in 1877, he worked for several years as construction engineer on the New York City elevated lines and railroad work in the state.

Joins New York Water Department

He began his three decades of service on the water supply system of New York City in 1884, being appointed assistant construction engineer by the Aqueduct Commission, and the following year was made division engineer in charge of construction of the Manhattan Division of the new Croton aqueduct. He served on this work for eight years, until 1893; the work included the tunnel under the Harlem River and the tunnel from 179th to 135th St. From 1893 to 1904 Mr. Wegmann was division engineer in charge of the Croton River division, including construction of the Muscoot Dam and extensive railroad and highway relocation.

In 1904 he was made the engineer for the Aqueduct Commissioners, and in 1907 was made consulting engineer. He remained in the position of chief engineer of the Aqueduct Commissioners until the commission was abolished in June, 1910. There followed a period of four years when he was consulting engineer to the Department of Water Supply, Gas and Electricity. This connection terminated in 1914 closing his 30 years of service in the New York City water supply development.

Since 1914 he had maintained private practice as consulting engineer.

Mr. Wegmann's name is known in the field of dam design as the author of the widely known volume "The Design and Construction of Dams," which was originally published in 1888 and had many subsequent editions. He also wrote "The Water Supply of the City of New York, 1658-1895," and was the author of many papers and technical articles. He had been a member of the American Society of Civil Engineers since 1888.

Railroad Company in Mexico To Build Four Coast Lines

Construction of four railroads, three from central Mexico to the Pacific Coast and one from the southern state of Oaxaca to the Gulf Coast state of Campeche, and the purchase of rolling stock and equipment for these lines is the prime object of a company to be known as Lineas Ferreas de Mexico, S.A., which will have a capital of about $16,000,000, that is being organized by the federal government under plans approved by President Cardenas. Capital for the enterprise will be raised by issues of two series of stock, one of which the national administration will take up to the extent of 75 per cent, and the other by public subscription. The government will turn over to the company, as part of its contribution to the capital, three railroads it owns in southeastern Mexico.

The railroads the company proposes to build, in accordance with the railroad phase of the Mexican six-year plan, are: From Ejutla, Oaxaca state, to a port on the Pacific Coast; from Uruapan, Michoacan state, to a point on the Balsas River, with a later extension to the Michoacan west coast; from Santa Lucrecia, Oaxaca state, to Campeche City, capital of Campeche state, and from Durango City, capital of Durango state, to the Pacific Coast port of Mazatlan.

Preliminary work, mostly surveys of routes, has been performed on all these lines by the National Railways of Mexico, but as the building of these railroads was found to be beyond the railways' economic possibilities, according to report, it was decided to organize the government company. All money that the federal government will put up for railroad works during the six year plan, which expires in 1940, is to be placed at the disposal of Lineas Ferreas de Mexico, S.A.

President's Message Insures Continuance of Public Works

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selected and planned so as to compete as little as possible with private enterprises. This suggests that if it were not for the necessity of giving useful work to the unemployed now on relief, these projects in most instances would not now be undertaken.

6. The planning of projects would seek to assure work during the coming fiscal year to the individuals now on relief, or until such time as private employment is available. In order to make adjustment to increasing private employment, work should be planned with a view to tapering it off in proportion to the speed with which the emergency workers are offered positions with private employers.

7. Effort should be made to locate projects where they will serve the greatest unemployment needs as shown by present relief rolls, and the broad program of the National Resources Board should be freely used for guidance in selection. Our ultimate objective being the enrichment of human lives, the government has the primary duty to use its emergency expenditures as much as possible to serve those who cannot secure the advantages of private capital.

Type of works

To indicate the various fields of activity which the new public works program will include, the President covered a wide variety of activity by including "clearance of slums, which for adequate reasons cannot be undertaken by private capital; rural housing of several kinds, where, again, private capital is unable to function; rural electrification; the reforestation of the great watersheds of the nation; an intensified program to prevent soil erosion and to reclaim blighted areas; improving existing road systems and constructing national highways designed to handle modern traffic; the elimination of grade crossings; the extension and enlargement of the successful work of the Civilian Conservation Corps; nonfederal work, mostly self-liquidating and highly useful to local divisions of government, and many others which the nation needs and cannot afford to neglect."

The message also stated that he would confer with Congress on the immediate subject of the consolidation of the federal regulatory administration over all forms of transportation.

Providence Plans $300,000 Storm Sewer Project

Plans are under way in Providence, R. I., for the construction of a storm sewer system on the East Side of the city which will involve a cost of about $300,000 if they are approved by the city council. At a meeting of the emergency public works committee last week, commissioner of public works Charles A. Maguire stated that the proposed construction would greatly relieve drainage conditions in the prescribed area and would relieve the sewage treatment plant at Fields Point of about 1.5 m.g.d. It is hoped to have the work done under the FERA, with the cost of labor and part of the cost of material to be borne by the government. A $150,000 program for sewer construction has already been approved.

SOCIETY CALENDAR

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York, Jan. 16-18.

AMERICAN ROAD BUILDERS, annual convention, Washington, D. C., Jan. 22-25.

AMERICAN WOOD-PRESERVERS ASSOCIATION, annual meeting, New York City, Jan. 22-24.

ASSOCIATED GENERAL CONTRACTORS, annual convention, Washington, D. C., Jan. 28-30.

CANADIAN CONSTRUCTION ASSOCIATION, annual convention, Montreal, Que., Jan. 29-31.

ENGINEERING INSTITUTE OF CANADA, annual meeting, Toronto, Ont., Feb. 7-8.

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Indianapolis, Ind., Feb. 7-8.

NATIONAL BITUMINOUS ASSOCIATION, meeting, Washington, D. C., Jan. 23.

AMERICAN SOCIETY FOR TESTING MATERIALS, regional meeting, Philadelphia, Mar. 6; annual meeting, Detroit, June 24-28.

AMERICAN WATER WORKS ASSOCIATION, annual convention, Cincinnati, Ohio, May 6-10.

NEW YORK STATE SEWAGE WORKS ASSOCIATION, seventh annual meeting, New York City, Jan. 15.

CONNECTICUT SOCIETY OF CIVIL ENGINEERS, annual meeting, New Haven, Feb. 19-20.

Survey of River Pollution To Be Made at Denver

Plans for the construction of a sewage disposal plant for the city and county of Denver were advanced a step this week when a crew of men furnished by the Federal Emergency Relief Administration began a survey to determine the effect of sewage on the South Platte River.

An investigation of health conditions in connection with the dumping of sewage into the South Platte River, extending from Denver to Brush, was made in 1932 by the state board of health. No action was taken at the time looking to the construction of a sewage disposal plant, but in January, 1934, there was submitted to the voters a proposal to issue $2,000,000 municipal bonds for the project. The Public Works Administration approved the proposed loan. The proposal was defeated by 700 votes. The estimated cost of the plant was $2,500,000.

Failure of the city to act resulted recently in the filing of a suit by Adams County for an injunction restraining the city and county of Denver from depreciating the value of property and menacing the health of citizens by permitting polluted water to flow through the county. This action is still pending in the courts. The Medical Society of the City and County of Denver has adopted resolutions urging the necessity of constructing sewage disposal plants by all communities dumping sewage into streams used for irrigation and the president of the state board of health has publicly called attention to the menace to health from the practice.

Mayor Begole has advised the board of health that a bond issue again will be submitted to the voters next May for approval. Prior to the election it is planned to have available detail estimates of the cost of constructing a complete treating plant and a sewage collecting system. It will be necessary to build the plant in or close to the city limits in order to treat the water above the Burlington ditch, a large canal furnishing water for irrigation over a large area.

Personals

ROBERT W. WILDER, assistant city engineer of Elkhart, Ind., has been appointed city engineer.

J. V. SMYTHE has been named bridge design engineer for the Indiana State Highway Commission.

J. L. ALBERS, city engineer of Glendale, Calif., has been elected president of the City & County Engineers Association of that state.

JOHN J. QUINN, Bedford, Ind., was elected president of the Indiana Highway Constructors, Inc., at the annual convention in Indianapolis.

MICHAEL C. O'NEILL has been appointed director of the division of smoke inspection for the Massachusetts Department of Public Utilities.

GEORGE H. MORROW, recently re-elected county surveyor of Howard County, Ind., will hold both that office and the position of city engineer of Kokomo, Ind., for the next two years.

ALFRED F. THEARD has been appointed superintendent of the Sewerage and Drainage Board, New Orleans, to succeed the late Bryson Vallas. Mr. Theard has been principal assistant engineer in charge of drainage.

WILLIAM F. CALLAHAN has been appointed commissioner of public works for the state of Massachusetts, succeeding Frank E. Lyman. FRANK E. LYMAN has been confirmed as associate commissioner of public works for the state.

CLARK JACKSON, formerly superintendent of public utilities at Seattle, Wash., has been named state director of the Federal Housing Act, succeeding James E. Bradford, who also holds the title of NRA compliance director for the state.

CHAUNCEY R. MCANLIS has been appointed city engineer of Fort Wayne, Ind. Since his graduation from Pennsylvania State College in 1910 he has been engaged in active engineering work and has had teaching experience at Cornell and Illinois Universities.

JOHN KLORER, chief engineer of the Orleans Levee Board, resigned Dec. 31 to accept the position of state engineer, filling the vacancy caused by the resignation of Harry Jacobs. Mr. Klorer was a former commissioner of New Orleans and prior to that held the office of city engineer.

EUGENE C. HULTMAN has been named chairman of the Boston Metropolitan District Commission. Mr. Hultman was at one time building commissioner of Boston and previously had had long service in the engineering department and executive staff of the former West End Street Railway.

THOMAS D. ALLIN, civil engineer of Pasadena, Calif., has been awarded the Arthur Noble medal, awarded annually, "in recognition of more than forty years of constant effort to advance and improve Pasadena." He is chairman of the city planning commission and has served as city engineer.

S. M. BAILEY has been transferred from the position of chief of the research section, U. S. Engineers office at Zanesville,

Ohio, to resident engineer on the Tappan Dam of the Muskingum water conservancy project.

C. W. HAASIS has been appointed assistant state engineer inspector for the PWA in the states of Tennessee and Kentucky with headquarters at Nashville.

Obituary

MICHAEL J. MURPHY, a civil engineer on the staff of the Canadian National Railways for many years, died at Moncton, N. B., Dec. 30.

W. C. MARION, former county engineer of Yakima county, Washington, and a pioneer in railroad construction work in the Pacific Northwest, died in Yakima, Wash., Dec. 28.

WILLIAM R. COPPAGE, construction superintendent, who was in charge of cable placing operations on the George Washington and Bear Mountain bridges across the Hudson River, died at his home in Elmhurst, L. I., N. Y., at the age of 60.

FRANKLIN C. HART, civil engineer with the Arkansas State Highway Department, and previously associated with the highway departments of Nebraska and Missouri, died at Fayetteville, Ark., Dec. 31, at the age of 39. He was a graduate of the University of Nebraska.

CHARLES E. PRICE, for many years engaged in civil engineering practice at New Haven, Conn., and earlier employed by the Pennsylvania Railroad on tunnel construction work and the New York Board of Water Supply, died at his home in Somerset, Mass., Dec. 30, at the age of 55.

JAMES B. PUFFENBERGER, engineer of Seneca county, Ohio and previously resident state highway engineer of the same county, prior to his election in 1932, died Dec. 27 of injuries received in an automobile accident at Tiffin, Ohio. He was 31 years of age and a graduate of Ohio Northern University.

BURT M. MCDONALD, civil engineer of many years service on the staff of the New York Central Railroad, died Dec. 31 at his home in Buffalo, N. Y., at the age of 62. He was a graduate of Lehigh University, and for the last eleven years of his service with the New York Central he has been stationed with the Buffalo division.

HENRY LLEWELLYN JONES, engineer and business representative of the United States Steel Products Corp. and its subsidiaries for more than 44 years, died in a New York hospital Jan. 1 at the age of 64. For many years he was an engineer for the American Bridge Co. stationed in Sydney, Australia, and later represented the United States Steel Corp. in the development of foreign trade, traveling widely in Europe and South America. Two years ago he was awarded a medal by the corporation for his 42 years of service.

CONSTRUCTION STATISTICS OF THE WEEK

ENGINEERING construction for the week at $31,883,000 is higher in all major subdivisions. Private work totals $4,486,000 and public, $27,397,000, of which $7,418,000 is federal and $19,979,000 state and municipal. Federal awards are running below a year ago with state and municipal awards materially higher.

As to classes of work, streets and roads are exceptionally high, $10,583,000; earthwork and waterways, $6,200,000; public buildings, $4,826,000; bridges, $2,755,000; waterworks, $1,293,000; sewerage, $1,547,000; private unclassified work totaled $3,045,000 while commercial buildings awards were low at $588,000 and industrial buildings at $853,000.

The larger awards for the week include 12 story courthouse, Alameda County, Oakland, Calif., $1,569,000; highway awards by Nebraska, $1,052,000; by Texas, $574,000 and $720,000; by Wisconsin, $708,000 and by New York, $546,000. The federal awards for waterways include Dam 5A, Mississippi River at Winona, Minn., $1,564,000; Willis Creek Dam, Conesville, Ohio, $624,000; and dam on Ohio River at Apple Grove, Gallipolis, Ohio, $3,118,000. The private awards included the race track, grandstand, hotel, paddocks, etc., for Berkshire Recreation Center, Lenox, Mass., $3,000,000.

New capital for the week includes municipal bond sales for construction totalling $5,561,000, net additions to non-federal PWA allotments of $84,000 and federal allotments amounting to $830,000.

CONTRACTS

(Thousands of Dollars)

	Weekly Average Jan. 1934	Prev. 4 Weeks	Week Jan. 10 1935
Federal Government	$15,532	$3,170	$7,418
State and municipal	14,321	14,773	19,979
Total public	$29,853	$17,943	$27,397
Total private	3,542	5,889	4,486
Week's total	$33,395	$23,832	$31,883
Cumulative to date:			
1934 ... $87,000,000	1935 ... $52,033,000		

NEW PRODUCTIVE CAPITAL

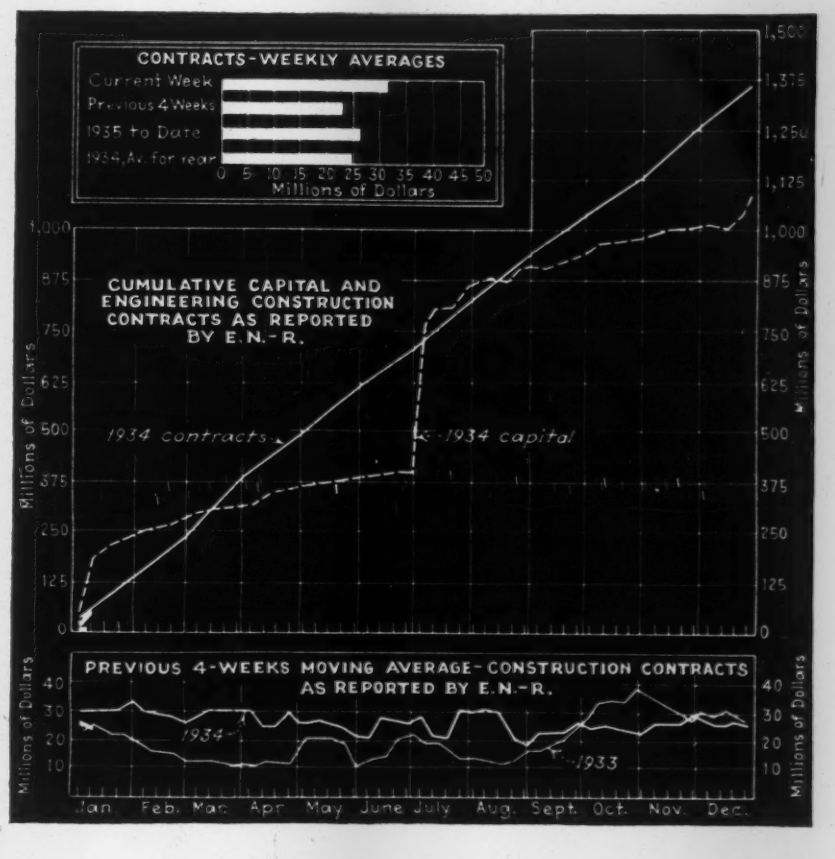
(Thousands of Dollars)

1934	Week Jan. 10	Cumulative
State and municipal	$5,561	$9,666
PWA allotments, S&M	84	84
RFC loans, S&M	.....	.....
Corporate issues	.....	.....
PWA allotments, private	.....	.....
Total, Non-Federal	$5,645	$9,750
PWA allotments, Federal Constr.	830	830
Total new capital	$5,475	$10,580
Cumulative to date:		
1934 ... $133,908,000	1935 ... $10,580,000	

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, including the special highway funds; PWA private loans, and allotments for Federal construction.

INDEX NUMBER

E.N.-R.- Cost	1913 — 100	1926 — 100	E.N.-R.- Volume	1913 — 100	1926 — 100
Jan., 1935	198.72	95.52	Dec., 1934	105	46
Dec., 1934	201.86	97.03	Nov., 1934	115	50
Jan., 1934	191.26	91.94	Dec., 1933	116	51
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47
1932 (Av.)	156.97	75.45	1932 (Av.)	127	56


CONTRACTS - WEEKLY AVERAGES
Current Week
Previous 4 Weeks
1935 to Date
1934, Av. for year
0 5 10 15 20 25 30 35 40 45 50
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY E.N.-R.
1934 contracts
1934 capital
Millions of Dollars
0 125 250 375 500 625 750 875 1,000 1,125 1,250 1,375 1,500
PREVIOUS 4-WEEKS MOVING AVERAGE - CONSTRUCTION CONTRACTS AS REPORTED BY E.N.-R.
1934
1933
10 20 30 40
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Current Construction Unit Prices

Sewer Mains for Granite, Okla.

CONTRACT was awarded Oct. 22, 1934, on a vitrified pipe sewer main for Granite, Okla., under a PWA allotment. Five proposals were submitted, all unusually close, ranging from the contract price of $28,500 to $29,790. Following are unit prices as submitted by the three low bidders: (A) W. G. Humphreys, Omaha, Neb., (contract) $28,500; (B) Asplund Construction Co., Enid, Okla., $28,900; (C) Keller Construction Co., Dallas, Tex., $29,250. W. R. Willis is engineer in charge.

SEWER MAINS, GRANITE, OKLA.

Item	Unit Prices A	B	C
1. Vitrified sewer pipe—8 in.	$0.90	$0.80	$0.96
2. Vitrified sewer pipe—10 in.	1.04	.94	1.05
3. Vitrified sewer pipe—12 in.	1.17	1.10	1.30
4. Standard manhole	75.00	60.00	80.00
5. Small concrete manhole	45.00	60.00	48.00
6. Wyes—12 in. x 6 in.	1.50	1.75	2.00
7. Wyes—10 in. x 6 in.	1.00	1.50	1.50
8. Wyes—8 in. x 6 in.	.75	1.00	1.25
9. Rock excavation, trenches	4.00	3.00	3.50
10. Reinforced concrete	17.50	20.00	25.00
11. Fence, per l.f.	1.00	1.50	1.10

Reading Water Tunnel, Dam and Conduit

THREE CONTRACTS were awarded in March, 1934, for Reading's new Maiden Creek water supply system. The major project, I—one-half mile concrete lined tunnel of 6 ft. 9 in. finish bore, is scheduled for July, 1935 completion; the other contracts: II—a seven eighths mile precast concrete conduit following the east bank of the creek, 60 in. in diameter and with a capacity of 40 m.g.d., will be completed this fall. Contract I, awarded originally to Walter S. Rae, Pittsburgh, was abandoned in August under conditions described in *ENR*, Sept. 6, 1934. Four bids for the incompleted portions were received Oct. 17, 1934, and the contract was awarded to Joseph Lombardi, Philadelphia. In March five alternates were taken for both the tunnel and open cut, with lineal ft. prices ranging from $54.70 to $88.00 for the circular sections; the Oct. prices ranged from $71 to $128.

Contract II, described in *ENR*, Sept. 13, 1934, consists of an earth dam 2,400 ft. long, faced with riprap on the upstream slope. The concrete corewall is of varying top profile, resting on a concrete mat. More than 20,000 cu.yd. of selected backfill will be used to fill the trench to the corewall top. In Contract III, for the conduit, alternates were included for, (a) poured in place concrete pipe without lining, and (b) poured in place concrete pipe with steel lining.

Eleven bids were received on the dam, and ten each on the conduit and tunnel (in March). Tenders ranged from $179,253 to $222,841 on Contract I; $82,993 to $175,850 on II; and from $79,873 to $135,188 on III. The total bids and the units of the lowest bidders follow. On Contract I, the lowest bid secured in March is compared with Lombardi's bid then and with his present successful bid for the incompleted portions.

CONTRACTORS AND TOTAL BIDS

I—Tunnel construction	
A—Walter S. Rae (contract abandoned) Pittsburgh, Pa.*	$179,253.00
B—Joseph Lombardi, Philadelphia, Pa. (March bid)	222,841.00
C—Joseph Lombardi, Philadelphia, Pa. (contract on Oct. bid)	235,123.00
II—Earthern portion of Ontelaunee dam	
D—Gannet, Seelye & Fleming, Engineers, Inc. (contract.), Harrisburg, Pa	$82,992.50
E—American Pipe & Construction Co., Amsterdam, N. Y.	90,333.50
F—Edward H. Ellis, Westville, N. J.	90,430.00
III—Precast concrete conduit	
G—T. M. Flanagan (contract), Reading, Pa.	79,873.11
H—Lock Joint Pipe Co., East Orange, N. J.	81,038.00
J—Chas. D. Land, Philadelphia, Pa.	94,819.50

*Contractor terminated contract Aug. 28. Re-advertised for bid opening Oct. 17, 1934.

COMPLETE UNIT PRICES OF THREE LOW BIDDERS

I—Maiden Creek Tunnel Item Quantities	Bidder and unit prices A	B	C
1. Cofferdam (lump sum)	$6,000.00	$5,000.00	$11,000.00
2. Upstream portal (lump sum)	1,000.00	250.00	5,000.00
3. Downstream portal (lump sum)	500.00	250.00	2,500.00
4. Tunnel, incldg. lining for 5'6" x 5'6" horseshoe section, 2,358 lin. ft.	44.50	69.00	.....
4a. Tunnel as No. 4, for 7'0" x 6'9" section, 2,358 lin. ft.	57.20	75.00	.....
4b. Tunnel as No. 4, for 5'4" dia. circular section, 2,358 lin. ft.	42.60	70.25	.....
4c. Tunnel as for No. 4, 6'9" dia. circular section, 2,358 lin. ft.	54.70	76.00	71.00
5. Conduit in open trench for 5'6" x 5'6" horseshoe section, 411 lin. ft.	50.00	36.00	.....
5a. Conduit as No. 5, for 7'0" x 6'9" horseshoe section, 411 lin. ft.	50.00	56.00	.....
5b. Conduit as No. 5, for 5'4" circular section, 411 lin. ft.	50.00	36.50	.....
5c. Conduit for 6'9" circular section, 411 lin. ft.	50.00	43.00	70.00
6. Earth excavation for downstream terminal structure, 1,100 cu. yd.	0.30	1.00	0.25
7. Rock excavation for downstream terminal structure, 500 cu. yd.	2.50	5.00	0.50
8. Concrete for terminal structures, 350 cu. yd.	20.00	10.00	15.00
9. Steel reinforcement for structures, 70,000 lb.	0.05	0.04	0.04
10. Cast iron manhole frames & covers, 4.	60.00	50.00	50.00
11. Misc. iron & steel, 6,000 lb.	0.10	0.06	0.06
12. Piping and valves (lump sum)	9,300.00	10,000.00	12,000.00
II—Earthen Portion of Ontelaunee Dam	D	E	F
1. Clearing and grubbing (lump sum)	$100.00	$100.00	$200.00
2. Stripping, 9,000 cu. yd.	0.30	0.48	0.40
3. Earth excavation for core wall and cutoff trench, 21,400 cu. yd.	0.25	0.48	0.30
4. Rock excavation for No. 3, 450 cu. yd.	5.00	3.00	5.00
5. Concrete core and cutoff walls, 1,800 c. y.	12.25	12.25	12.00
6. Backfill for No. 5, 20,200 cu. yd.	0.40	0.22	0.20
7. Rolled clay embankment, 65,750 cu. yd.	0.29	0.29	0.40
8. Broken stone, upstream slope, 1,950 cu. yd.	2.50	2.75	3.00
9. Riprap, 10,550 cu. yd.	0.50	1.15	1.00
10. Grout holes, 3,310 lin. ft.	2.55	1.75	0.40
11. Grout, 4,200 bags	1.15	1.30	2.00
III—Maiden Creek Conduit	G	H	
1. Clearing and grubbing (lump sum)	$50.00	$500.00	$500.00
2. Earth excavation for No. 6, 9,700 cu. yds.	0.70	0.70	1.20
" " " " 6a, 8,040 " "	0.70	.....	1.20
" " " " 6b, 6,840 " "	.....	.....	1.20
3. Rock excavation for No. 6, 750 " "	4.50	4.50	5.00
" " " " 6a, 660 " "	4.50	.....	5.00
" " " " 6b, 410 " "	.....	.....	5.00
4. Fill over top of trench, 7,850 cu. yds.	0.40	0.70	0.35
5. Riprap, 470 cu. yds.	1.90	2.50	4.00
6. Precast concrete pipe, 4,644 lin. ft.	13.75	13.25	15.50
6a. Poured in place concrete pipe without lining, Alternate A, 4,644 lin. ft.	16.50	.....	16.12
6b. Poured in place concrete pipe with steel lining, Alternate B, 4,644 lin. ft.	.....	.....	23.50
7. Concrete, Class A, 50 cu. yds.	16.75	20.00	20.00
8. " " B, 10 " "	10.00	15.00	15.00
9. Steel reinforcement, 6,000 lbs.	0.04	0.05	0.06
10. C. I. manhole frames and covers, 7	172.61	300.00	600.00
11. Cast iron pipe (lump sum)	172.61	300.00	600.00

Muskingum Valley Dams, Ohio

BIDS WERE taken in November, 1933, for the first three of flood control dams planned by the Muskingum Valley Conservancy District and the U. S. Engineers for the Muskingum Valley in southeastern Ohio. Contracts were let early in December for two of them: Charles Mill Dam on Black Fork and Tappan Dam on Stillwater Creek. Contract for the third, Wills Creek Dam, has just been let. All three dams are rolled earth fills. The following tables give the characteristics of each dam, the list of three low bidders on each project and the unit prices of these bidders. Maj. J. D. Arthur, District Engineer, Zanesville, is in charge.

THREE LOW BIDDERS MUSKINGUM VALLEY DAMS

Contractor	Total Bid
Charles Mill Dam:	
(A) Ryan & Myers, Campbellsburgh, Ind. (contract)	$313,895
(B) American Aggregates Corp., Greenville, O.	382,118
(C) Geo. M. Brewster & Son, Bogota, N. J.	382,419
Tappan Dam:	
(D) Sammons-Robertson, Inc., Huntington, W. Va. (contract)	387,450
(E) Culbertson Const. Co., Cleveland	388,375
(F) Bates & Rogers Const. Co., Chicago	431,422
Wills Creek Dam:	
(G) Edw. J. Eiff, Quincy, Ill. (contract)	628,007
(H) Wm. Eisenberg & Sons, Inc., Camden, N. J.	674,853
(I) Culbertson Const. Co., Cleveland	699,485

CHARACTERISTICS OF MUSKINGUM VALLEY DAMS

	Charles Mill	Tappan	Wills Creek
Low bid	$313,894.80	$387,450.00	$628,007.50
Schedule time	1 year	1 year	2 years
Construction	Rolled earth fill, 6 in. layers. Concrete cutoff wall into fdts., riprap, stilling basin.	Rolled earth fill, 6 in. layers. Concrete keywalls into rock each embankm't. Riprap, stilling basin.	Rolled earth fill 6 in. layers. Cutoff trench-impervious fill into fdts. Riprap, stilling basin.
Length	Main dam 1,350 ft. Dikes (1) 1,400 ft.; (2) 300 ft.	1,400 ft.	2,000 ft.
Outlet struct.	Five concrete conduits each 3½x7x35 ft.	Conduit 90x7½x8 ft. Tunnel 480x7½x8 ft. on left embankment.	Two concrete conduits each 250x15x20 ft. on left embankment.
Control gates	Five each 3½x7 ft. One each 3½x5 ft.	Three each 3½x7 ft.	Six each 6x15 ft.
Spillway and channel	Two sections on right embankment. First over conduits, second 5 ft. above to right of first, 1,100x65 ft.	In saddle left of left embankment, 650x75 ft.	Side channel, right abutment, 1,200x50 ft.
Weir	Concrete ogee for each section.		Natural rock, 160 ft. 2 ft. conc. erosion cap.
Materials furnished	Cement, reinf. steel, outlet gates.	Same as Charles Mill.	Same as Charles Mill.
PWA wage scales (minimum)	Skilled 1.20 Semi Skilled .55 Common Skilled .50	Same as Charles Mill.	Same as Charles Mill.

COMPLETE UNIT PRICES OF THREE LOWEST BIDDERS ON EACH OF THREE MUSKINGUM VALLEY DAMS

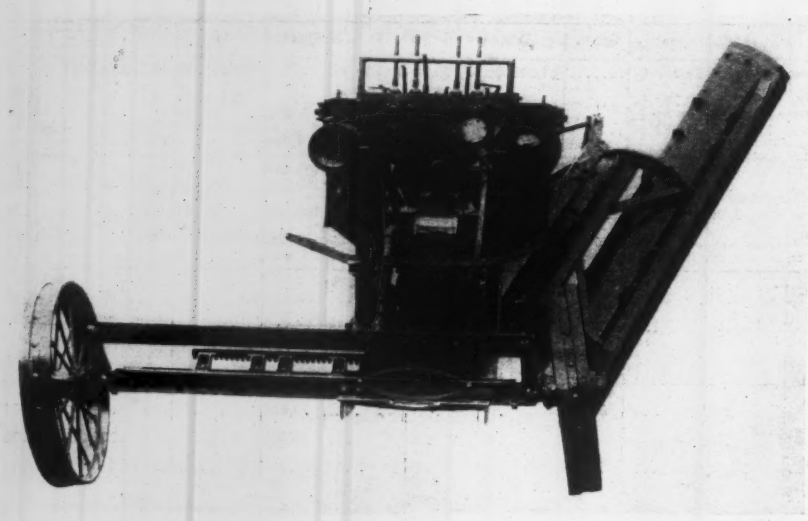
	Item	Charles Mill				Tappan				Wills Creek			
		Quan.	A	B	C	Quan.	D	E	F	Quan	G	H	I
1	River diversion—lump sum	.....	$4,000.00	$3,500.00	$6,000.00	.....	$4,000.00	$7,500.00	$8,700.90	.....	$15,000.00	$7,537.00	$27,500.00
2	Remove existing structures—lump sum	.....	250.00	1,100.00	750.00	.....	1,000.00	3,500.00	800.00	.....	3,000.00	6,475.15	2,000.00
3	Clear reservoir site—acres	416	20.00	20.00	80.00	283	20.00	55.00	60.00	192	60.00	25.00	50.00
4	Clear and grub dam site—lump sum	.....	250.00	1,200.00	1,600.00	.....	1,000.00	2,000.00	375.00	.....	4,000.00	7,500.00	2,500.00
5	Embankment stripping—cu.yd	12,000	.25	.25	.43	16,000	.60	.30	.44	28,000	.20	.237	.32
6	Common excavation—cu.yd	142,000	.25	.30	.24	90,000	.30	.23	.12	405,000	.18	.297	.26
7	Borrow pit excavation—cu.yd	360,000	.11	.15	.10	400,000	.10	.21	.10	150,000	.14	.356	.07
8	Rock excav., spillway channel—cu.yd	27,000	.60	2.00	.95	56,000	.53	.60	.68	109,000	.61	.83	.78
9	Rock excav., intakes and stilling pools—cu.yd	.....	.....	.....	.....	6,600	1.00	1.00	1.10	1,200	1.80	4.16	4.00
10	Rock excav., trenches—cu.yd	550	2.00	5.00	5.00	.....	.....	.....	.....	600	.50	.30	.60
11	Structural backfilling, uncompacted—cu.yd	400	.20	.75	.65	.....	.....	.....	.....	.....	.....	.....	.....
12	Structural backfilling, compacted—cu.yd	1,800	.60	1.00	1.25	1,700	.50	80	.60	1,100	1.00	.594	1.00
13	Impervious fill, main dam—cu.yd	167,000	.16	.17	.20	385,000	.29	.08	.32	345,000	.14	.0713	.20
14	Pervious fill, main dam—cu.yd	80,000	.16	.15	.19	.....	.....	.....	.....	.....	.....	.....	.....
15	Earth fill, dikes—cu.yd	125,000	.16	.15	.17	.....	.....	.....	.....	.....	.....	.....	.....
16	Rolling, each add'l 3 trips—100-ft.sq	50,000	.005	.02	.01	80,000	.01	.015	.022	75,000	.02	.03	.01
17	Pervious material, main channel—cu.yd	12,000	.25	.50	.24	6,600	.30	.20	.22	45,000	.20	.297	.30
18	Excav., tunnel intake, stilling struc.—cu.yd	.....	.....	.....	.....	11,000	.30	.30	.30	.....	.....	.....	.....
19	Excav., keywall trench—cu.yd	.....	.....	.....	.....	420	1.00	2.00	.52	.....	.....	.....	.....
20	Rock excav., keywall—cu.yd	.....	.....	.....	.....	110	1.50	10.00	3.00	.....	.....	.....	.....
21	Tunnel excav.—cu.yd	.....	.....	.....	.....	1,900	7.00	10.00	6.00	.....	.....	.....	.....
22	Tunnel timbering—lin.ft. tunnel	.....	.....	.....	.....	50	12.00	7.00	31.20	.....	.....	.....	.....
23	Rock fill, amb. and toe trench—cu.yd	15,000	.50	.25	.33	35,000	.40	.60	.44	120,000	.60	.297	.35
24	Sodding—acres	3	200.00	400.00	770.00	6	200.00	200.00	1,760.00	.....	.....	.....	.....
25	Sand and gravel fillings, drains—cu.yd	6,600	.60	1.25	3.15	12,000	2.50	2.50	3.25	26,000	1.50	1.90	2.20
26	Rock paving—sq.yd	500	4.50	3.00	2.55	150	3.00	5.00	1.75	4,000	1.00	2.50	2.50
27	Gravel road surfacing—sq.yd	1,700	.30	.40	1.05	2,800	.75	1.00	.52	.....	.....	.....	.....
28	Riprap, hand placed—cu.yd	.....	.....	.....	.....	7,300	2.75	3.00	2.20	.....	.....	.....	.....
29	Haul and store cement—bbl	16,000	.20	.30	.25	5,500	.20	.20	.25	25,000	.30	.202	.20
30	Place reinforcing steel—lb	150,000	.02	.02	.02	80,000	.03	0.12	.022	800,000	.02	.02	.02
31	Drill holes, rock or concrete—lin.ft	2,600	50	.80	1.25	500	.50	.80	.60	2,800	.50	1.00	.60
32	Pressure grouting—cu.ft	500	.75	.80	1.25	500	.50	.80	1.55	500	1.00	1.50	1.20
33	Concrete, outlet and spillway struc.—cu.yd	3,300	9.72	7.40	7.20	600	9.90	12.00	9.25	7,800	7.50	7.76	7.50
34	Concrete, piers—cu.yd	580	12.22	7.40	10.60	.....	.....	.....	.....	.....	.....	.....	.....
35	Concrete, retaining walls—cu.yd	6,200	7.88	7.40	7.85	.....	.....	.....	.....	.....	.....	.....	.....
36	Concrete, apron—cu.yd	1,070	7.88	7.40	6.80	.....	.....	.....	.....	2,600	8.50	6.39	7.50
37	Concrete, keywall—cu.yd	450	7.09	7.40	11.75	700	9.90	14.50	14.00	70	15.00	25.00	13.00
38	Concrete, service bridge—cu.yd	130	12.22	7.40	25.15	.....	.....	.....	.....	.....	.....	.....	.....
39	Concrete, intake and misc.—cu.yd	.....	.....	.....	.....	1,400	11.00	12.50	11.80	6,500	9.50	8.98	9.00
40	Concrete, tunnel and conduit—cu.yd	.....	.....	.....	.....	1,100	9.90	12.00	15.50	3,200	8.50	7.84	8.50
41	Install gates—lb	100,000	.02	.02	.025	60,000	.02	.02	.03	650,000	.02	.015	.02
42	Grout gate recesses—cu.yd	38	20.00	25.00	12.40	20	15.00	14.00	14.85	110	15.00	20.00	15.00
43	Furnish & install misc. struct. steel—lb	69,000	.067	.10	.08	55,000	.10	.078	.10	98,000	.08	.08	.08
44	Furnish & install misc. light iron—lb	7,200	.15	.15	.13	6,500	.12	.20	.14	34,000	.11	.10	.20
45	Furnish & install pipe railing—lb	3,400	.20	.15	.25	5,000	.20	.28	.14	12,000	.06	.20	.20
46	Furnish & install misc. iron pipe—lb	1,800	.22	.15	.25	3,000	.25	.18	.14	12,000	.06	.20	.12
47	Furnish & install misc. brass pipe—lb	50	.50	.50	1.30	30	1.00	.75	.75	25	1.00	1.00	1.00
48	Furnish & install copper water stops—lb	1,700	.45	.45	.65	800	.50	.35	.45	4,000	.30	.40	.40
49	Furnish & install trash trolley hoist—lump sum	.....	1,807.50	750.00	2,000.00	.....	1,500.00	1,500.00	2,400.00	.....	.....	.....	.....
50	Elec. conduits—lb	860	.40	.60	.60	620	.60	.60	45	1,650	.25	.50	.40
51	Furnish & install lighting system—lump sum	.....	889.00	400.00	1,000.00	.....	828.00	400.00	600.00	.....	719.00	1,000.00	500.00
52	Operating house superstructure—lump sum	.....	3,850.00	2,500.00	7,500.00	.....	5,000.00	9,000.00	7,000.00	.....	20,000.00	11,881.00	22,500.00
53	Install emergency gate hoist—lb	.....	.....	.....	.....	.....	.....	.....	.....	9,000	.08	.10	.05
54	Highway guard rail—lin.ft	3,000	.70	.60	.70	1,600	.75	1.06	.80	4,400	1.00	1.20	.60

Construction Equipment and Materials

Leaning-Wheel Grader With Power-Operated Controls

The availability of power-operated controls on Adams leaning-wheel grader No. 22 (10-ft. blade) is announced by J. D. Adams Company of Indianapolis, Ind. The power control mechanism is of the same type as has been used on the company's 12-ft. blade machines for several years.

Power is supplied by a single-cylinder, 5½-hp., air-cooled motor mounted forward of the operator's platform, from where the power is transmitted by roller chain and sprockets to the power control box in front of the operator. All operating adjustments are made through levers, including leaning of the wheels, vertical and lateral adjustment of the blade, and operation of the steerable tongue. The manufacturer claims that these mechanical controls are positive in action and permit positive and accurate adjustments. Further, two or more adjustments can be made as quickly as one.



POWER-OPERATED CONTROLS on Adams leaning-wheel grader.

The machine weighs about 7,250 lb. and is intended for use with tractors of 40 to 50 drawbar hp. Hand-operated controls are also available.

Vacuum Control for Clutches of Power Excavator

Vacuum control for the swinging clutches of power excavators has been announced by the Osgood Co., Marion, Ohio. Vacuum is taken from the engine of the excavator and led to a two-way valve at the operator's position, from which it controls all the swinging and traveling portions of the machine.

A flexible line is led from the engine manifold to a reservoir which stores up enough vacuum to operate the clutches several times. The vacuum is applied to the clutches through an arm connected to a cylinder that operates the clutch whenever the control valve is operated. A forward movement of the valve lever swings the machine to the right, and a similar movement in the opposite direction swings it to the left. The length of travel of the valve does not exceed 3 in.

This new operating device is available on all new Osgood machines and can be put on any now in service. The maker states that the vacuum used is but a small part of that created by the engine, and its use does not detract from the efficiency of the prime mover.

New Equipment in Brief

Concrete Floor Finish. A new development by the Master Builders Co., Cleveland, Ohio, known as "Super-Colorseal," a rubber-base colored finish, is offered as a practical method of painting basement floors in residences, stores, churches, and for power houses and other concrete floors lying directly on the ground. The maker states that "Super-Colorseal" is resistant to moisture penetration from below.

Gate Valves. A clip-type gate valve with several new features has been announced by the Reading-Pratt & Cady Co., Inc., Bridgeport, Conn. The valve has a round bonnet and a full U-bolt is used to hold the bonnet joint tight. Among the internal features there is a full-thickness I-beam cast wedge. A horseshoe connection is used to assemble the spindle and wedge.

Joint Filler. A fibre-asphalt type of filler for expansion joints used on the West Coast for some time has recently been put on the market in eastern territory by the Flexcell Company, Chicago. It is claimed to have compressibility to one-half its original thickness without showing objectionable extrusion, ability to re-expand on release of compression, durability of the side wall material to withstand the elements and economy. It has a board-like structure made of long, spring-like fibers of cane that are felted into a resistant board, containing innumerable air cells. It is treated with a special asphaltic waterproofing compound.

Tractor. Bates Mfg. Co., Joliet, Ill., announces their new model 35 tractor. The maker states that a new design for the main engine clutch and transmission eliminates rear end engine vibration. The crawler housing supporting the track idlers has been extended to give greater protection to the drive sprocket. Greater clearance has been introduced between the truck wheel flanges and track rails. The tractor has a drawbar pull of slightly over 43 hp. and can be powered for either diesel, oil or gasoline.

Business Notes

REVERE COPPER & BRASS, INC., New York, announces that it has opened an office at Dallas, Texas, at 1905 Elm Street.

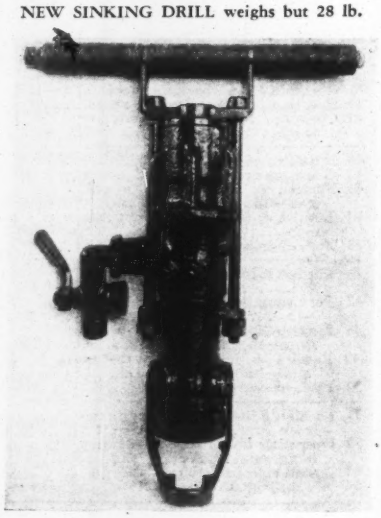
BLAW-KNOX, Pittsburgh, Pa., announces that Chester H. Lehman has been appointed vice-president in charge of sales.

WORTHINGTON PUMP & MACHINERY CORP., Harrison, N. J., has recently established a Pacific Coast regional headquarters at Los Angeles, Calif., which will center jurisdiction and development of the corporation's business in the western territory now included in the coverage of the Worthington district offices in Seattle, San Francisco, Los Angeles and El Paso.

New Light-Weight Sinking Drill Announced by Gardner-Denver

A new 28-lb. sinking drill, known as the S-35, has been announced by the Gardner-Denver Co., Quincy, Ill. The manufacturer states that it combines the desirable characteristics of powerful rotation, satisfactory blowing and easy riding.

Owing to its light weight, the new drill is easy to handle in places inaccessible to a heavier drill, and is especially suited for drilling in soft and medium formations, as well as for plugging in quarries or on construction jobs.

It has a full-grip D handle, short throw tubular valve totally enclosed, one-piece exhaust-control valve and handle, and simple rugged steel puller. The air inlet is conveniently placed; and there are no side-rod springs.

NEW SINKING DRILL weighs but 28 lb.